

Program Outcome, Program Specific Outcome & Course Outcome**Program Name: PGDMLT****Academic Year: 2019-20****Program Outcome:**

Postgraduate diploma in medical laboratory technology (PGDMLT) is a paramedical course of 1 year. This course provides analytical skills in different areas of clinical laboratory, clinical research and quality standards. In the rapidly growing area of scientific knowledge and skills, laboratory science is an important area of study for medical laboratory technicians. It delivers the knowledge in the field of Hematology, Clinical Pathology, Microbiology, Biochemistry, Serology and Immunology, Histopathology, Cytopathology and Transfusion Medicine.

Mission:

To respond to the developmental needs of the society by offering skilled and trained Technicians & manpower for the growing Health Industry, With a focus on developing their future career in the growing Health Sector. The mission of the Medical Technology/Clinical Laboratory Science program is to provide an excellent educational program embodying a curriculum that prepares students to become competent professionals who are committed to providing quality patient care, serving the community, and advancing the body of knowledge in clinical laboratory science and technology

Objectives:

1. To educate and train a person to a skilled level of expertise in the domain area of the growing Health Sector.
2. To enable the students to acquire knowledge of Pathological laboratory and operation of ground based growing Health Industry needs.

Program Outcomes:

- Perform routine clinical laboratory procedures within acceptable quality control parameters in Hematology, Chemistry, Immunochemistry, and Microbiology under the general supervision of a Clinical Laboratory Scientist or Pathologist.
- Demonstrate technical skills, social behavior, and professional awareness incumbent upon a laboratory technician
- Apply systematized problem solving techniques to identify and correct procedural errors, identify instrument malfunctions and seek proper supervisory assistance, and verify the accuracy of laboratory results obtained.
- Operate and maintain laboratory equipment, utilizing appropriate quality control and safety procedures.

- Recognize and participate in activities which will provide current knowledge and upgrading of skills in laboratory medicine or health science.

Program Specific Outcome:

The PGDMLT course is career oriented course that opens up new horizons to work in medical or clinical laboratory, blood bank, hospital, clinic, health centers, forensic and genetic science, pharmaceutical company and research organizations

FUTURE AND IMPORTANCE

- Medical Laboratory Technology is a one year Post Graduate Diploma course in which the technicians are given the basic knowledge of diagnostic technique and prognosis of various clinical conditions.
- These technicians serve to offer the assistance to doctors with clinical laboratory tests, performing the vital role in diagnosis of various clinical conditions.

Course Outcome (Subject wise):

1	Course (subject) Code	DMLT 1
	Subject Title	MEDICAL MICROBIOLOGY & IMMUNOLOGY
	SECTION – I	MEDICAL MICROBIOLOGY
	Subject Outcome	The Medical Microbiology course has been formulated to impart basic and medically relevant information on the microbes. The microbial structure, growth and development, methods and role of sterilization in the context of study of microbes are included. The pathogenic microbes and the diseases caused by them are included to broaden the perspective of the subject. This course will also focus on mechanisms of microbial pathogenesis and the host response, and the scientific approaches that are used to investigate these processes. Lastly the course deals with the problem of emerging antimicrobial resistance with reference to known pathogens.
	SECTION – II	IMMUNOLOGY
	Subject Outcome	The students will learn how to analyze various clinical patients samples, for estimation of different components which are the cause of the immune disease or are the diagnostic/prognostic markers. This subject gives information about various clinically important cells of immune system, lymphoid organs, antigen (Ag), antibody (ab), Ag-Ab reactions, transplant immunology etc. & automation techniques.

2	Course (subject) Code	DMLT 2
	Subject Title	CLINICAL PATHOLOGY & PARASITOLOGY
	SECTION-I	CLINICAL PATHOLOGY
	Subject Outcome	The candidates are imparted basic training of theoretical and practical in the field of clinical pathology. The training in this subject enables the students to carry out routine clinical laboratory investigation (on samples i.e urine, stool, sputum, semen, CSF & Other body fluids etc.). The candidates are made to learn collection of clinical samples and their processing along with basic histopathological technique and recording of data.
	SECTION-II	PARASITOLOGY
	Subject Outcome	The candidates undergoing training medical laboratory technology are made to learn the techniques of collection of samples, their processing and identification of various parasitic pathogens, using different procedures with special reference to their habitat, morphology, life cycle and their isolation, identification for diagnostic purpose.
3	Course (subject) Code	DMLT 3
	Subject Title	HAEMATOLOGY & BLOOD BANKING
	SECTION-I	HAEMATOLOGY
	Subject Outcome	The training in this subject is imparted to enable the students to carry out routine clinical laboratory investigation in haematology or related to blood. Students will be made aware of the composition of blood and methods of estimating different components of blood. Students will learn the basic concepts of Haematology& routine clinical investigations of Haematology laboratory,They should be able to provide technical help for selected sophisticated haematological techniques with adequate knowledge of various principles. Disposal of waste following National Policy,
	SECTION-II	BLOOD BANKING
	Subject Outcome	The candidates are taught the skill of blood collection from donors and aspects of proper collection of blood, documentation, preventive measures against communicable diseases etc. They should be able to perform different investigations, preservation and interpretation of blood for transfusion.

4	Course (subject) Code	DMLT 4
	Subject Title	FUNDAMENTALS IN MEDICAL LABORATORY TECHNOLOGY & CLINICAL BIOCHEMISTRY
	SECTION-I	FUNDAMENTALS IN MEDICAL LABORATORY TECHNOLOGY
	Subject Outcome	The main objective of the subject is to impart the knowledge of apparatus, units, equipment, and volumetric analysis in the medical/clinical laboratory and Biochemistry. The students are also given basic training in safety measures quality control and automation.
	SECTION-II	CLINICAL BIOCHEMISTRY
	Subject Outcome	The candidates are imparted specialized training of theory and practical in the field of clinical biochemistry. The students will learn how to analyze various clinical patients' samples, for estimation of different components which are the cause of the disease or are the diagnostic/prognostic markers. This subject gives information about various clinically important enzymes, biomolecules e.g protein, cholesterol, hormones, vitamins & learn special biochemical investigations of endocrine disorders like Diabetes, organ functions e.g. liver function test(LFT), kidney/renal function test (RFT), cardiac function test etc.

Signature of the Head

Dr. Jignaben P Naik

PGDMLT, Arts, Science & Commerce College, Kholwad , Surat



Re Accredited by NAAC with 'A' Grade

VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna Magdalla Road, SURAT - 395 007, Gujarat, India

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કમ્પસ, ઉદ્દના મગદલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત

Tel : ૦૨ ૨૬૧ - ૨૨૨૭૧૪૧ to ૨૨૨૭૧૪૬, Toll Free 1800 2333 011 Fax : ૦૨ ૨૬૧ - ૨૬૧ ૨૬૧
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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન મેડીકલ ટેકનોલોજી વિષય ચલાવતી અનુસ્નાતક કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૧૯-૨૦ થી અમલમાં આવનાર PGDMLTનો અભ્યાસક્રમ અંગે મેડીકલ ટેકનોલોજી વિષયની અભ્યાસસમિતિની તા.૩૦/૦૪/૨૦૧૯ની સભાનાં ઠરાવ ક્રમાંક: ૨ અન્વયે કરેલ નીચેની ભલામણ વિજ્ઞાન વિદ્યાશાખાની તા.૦૨/૦૫/૨૦૧૯ ની સભાનાં ઠરાવ ક્રમાંક : ૩૦ અન્વયે સ્વીકારી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલએ તેની તા.૦૭/૦૬/૨૦૧૯ ની સભાના ઠરાવ ક્રમાંક: ૫૭ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદઉપરાંત તેનો અમલ કરવો.

મેડીકલ ટેકનોલોજી વિષયની અભ્યાસસમિતિની તા.૩૦/૦૪/૨૦૧૯ ની સભાનાં ઠરાવ ક્રમાંક: ૨

:: આથી ઠરાવવામાં આવે છે કે, પેટાસમિતિએ તૈયાર કરેલ PGDMLTનો શૈક્ષણિક વર્ષ ૨૦૧૯-૨૦ થી અમલમાં આવનાર અભ્યાસક્રમ સર્વાનુમતે મંજૂર કરી તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા.૦૨/૦૫/૨૦૧૯ ની સભાનાં ઠરાવ ક્રમાંક : ૩૦

:: આથી ઠરાવવામાં આવે છે કે, પેટાસમિતિએ તૈયાર કરેલ PGDMLTનો શૈક્ષણિક વર્ષ ૨૦૧૯-૨૦ થી અમલમાં આવનાર અભ્યાસક્રમ સ્વીકારી તે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૭/૦૬/૨૦૧૯ ની સભાનાં ઠરાવ ક્રમાંક: ૫૭

:: આથી ઠરાવવામાં આવે છે કે, વિજ્ઞાન વિદ્યાશાખાએ તેની તા. ૦૨/૦૫/૨૦૧૯ ની સભાના ઠરાવ ક્રમાંક : ૨૯ અન્વયે ભલામણ કરેલ શૈક્ષણિક વર્ષ ૨૦૧૯-૨૦ થી અમલમાં આવનાર PGDMLTનો અભ્યાસક્રમ સ્વીકારી મંજૂર કરવામાં આવે છે.

બિડાણ: ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૧૦૪૫૧/૧૯

તા. ૨૧-૦૬-૨૦૧૯

ઈ.ચા. કુલસચિવ

પ્રતિ,

- ૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની મેડીકલ ટેકનોલોજી વિષય ચલાવતી સ્નાતક કોલેજોના આચાર્યશ્રીઓ.
- ૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા
- ૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વી. ન. દ. ગુ. યુનિવર્સિટી, સુરત.
- ૪) પી.જી. વિભાગ, વી. ન. દ. ગુ. યુનિવર્સિટી, સુરત.

...તરફ જાણ તેમજ અમલ સારું.

Circular

No. : A.C./Circular/10451/19

Date: 21/06/2019

The Principals of affiliated colleges and the Head of post-graduate department offering Medical Technology subject under the Faculty of Science are hereby informed that the consideration of syllabus of PGDMLT be implemented from the academic year 2019-20 according to the Resolution No.:30 in Academic Council of Faculty of Science dated 02/05/2019 has been accepted following request according to the Resolution No.: 2 in Academic Council of Medical Technology dated 30/04/2019 and approved according to the Resolution No.: 57 of Academic council dated 07/06/2019. Report it to the concerned teachers and students, and implement it.

Resolution No.: 2, Academic Council of Medical Technology dated 30/04/2019:

Therefore, it is resolved that the recommendation to the Faculty of Science for the approval of the PGDMLT Course prepared by the subcommittee to accept unanimously and allow it to implement from the academic year 2019-20

Resolution No.: 30, Academic Council of Faculty of Science dated 02/05/2019:

Therefore, it is resolved that the recommendation to the Academic Council for the approval of the PGDMLT Course prepared by the subcommittee to accept unanimously and allow it to implement from the academic year 2019-20

Resolution No.: 57, Academic Council dated 07/06/2019:

Therefore, it is resolved that the recommendation for the PGDMLT course to be implemented from the academic year 2019-20 by Faculty of Science dated 02/05/2019 according to the Resolution No.: 30 has been accepted and approved by the Academic Council

Attachment: As above

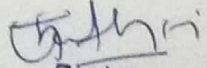
No. : A.C./Circular/10451/19

Date: 21/06/2019

I/C Registrar

To,

1. The Principals of affiliated colleges and the Head of post-graduate department offering Biosciences subject under the Faculty of Science
2. The dean, Faculty of Science
3. Exam Superintendent, Examination Department, V.N.S.G.University, Surat
4. P.G. Section, V.N.S.G. University., Surat


Registrar
Veer Narmad South Gujarat University
Surat.

ole
oP
Head
Department of Biosciences
Veer Narmad South Gujarat University,
Surat-395 007.

P.G.DIPLOMA

IN

MEDICAL LABORATORY TECHNOLOGY

Post Graduate Diploma in Medical Laboratory Technology (PGDMLT) is a one year Post-Graduate (Post B.Sc.) course.

1. Title of the Course: P.G. Diploma in Medical Laboratory Technology (PGDMLT)

2. Eligibility: Candidate should have a B.Sc. degree of Veer Narmad South Gujarat University, Surat with (A) or (B) or equivalent qualification of other recognized University.

(A) Microbiology, Chemistry (Biology at F.Y. B.Sc. level), Botany, Zoology, Medical Technology, MLT, Environment, Biochemistry, Biosciences, Life sciences or Biotechnology as the principal subjects

(B) M.B.B.S, BDS, BAMS, BHMS, B.sc Nursing, B.sc Optometry, B. Pharmacy, B. Physiotherapy

3. Admission: Admission to the course should be done once in a year. The course will begin in the month of July, each year (After declaration of B.Sc. results of Universities) and will extend over two academic terms – July to October and November to April.

4. Learning objectives:

1. To have theoretical and practical knowledge about principles, procedures, interpretation and preparation of reagents for routine clinical laboratory investigations performed for laboratory diagnosis of various human diseases, so that after completion of the course the candidate may be able to perform routine clinical laboratory investigations in any clinical laboratory.

2. To have theoretical and practical know-how in advanced newer techniques so that trained personnel can apply these wherever facilities exist.

The learner at the end of the course will –

- Be able to work as technician in laboratories attached to hospitals under the supervisions of senior officers like Biochemist, Microbiologist or Pathologist.
- They may be employed in a small laboratory functioning independently or attached to a doctor's clinic. Nature of the job dictates that the candidate should give more emphasis on learning of practical skills along with a basic knowledge of the subject.
- Be able to carry out the routine tests in all these fields personally. He / She will maintain effective quality control and provide the patient with reliable reports.
- Will acquire the necessary oriental knowledge and practical skill expected of him for the fulfillment of above objectives.
- Acquire theoretical knowledge and practical skill leading to further specialization in the elective field.
- Process information and ensure quality control as appropriate to routine laboratories
- Upgrade knowledge and skills in a changing healthcare scenario
- Appreciate and follow the ethical standards of the profession and will demonstrate qualities of honesty and accuracy towards his work and sympathy towards the suffering patients.

5. Duration: One Year (Full Time)

6. Pattern: Annual

7. Medium of Instruction: English

8. Structure of the Course:

i. Total number of papers: THEORY: 4; PRACTICAL: 4

A student offering this course will study Papers I, II, III, IV & Practicals based on these papers. The teaching per week for 4 papers is 16 hours & there are 16 hours per week for practicals.

ii. Pattern of Examination: The examination shall be held for 700 marks.

The total marks of papers are 280 for University examination, distributed as 70 of each paper of 3 hours duration & the internal evaluation is of 120 marks distributed as 30 of each paper. The total marks of practicals are 210 for University examination, distributed as 54 for practical paper-I & practicals papers II, III, & IV are each of 52 marks. The internal evaluation for practical is of 90 marks distributed as 24, 22, 22, & 22 for practical based on Paper I, II, III & IV respectively. The University examination for practicals based on paper I is of 12 hours distributed over a period of 2 days & for practicals based on paper II, III, & IV are of one day each & 6 hours per day.

Theory examination for four subjects shall be conducted on separate days. Practical examination for four subjects will be conducted on five consecutive days.

University examination for DMLT will be conducted at the end of the course i.e. after completion of two academic terms. For failed candidates, midterm examination will be conducted in month of October or November.

iii. Nature of Question Paper (Theory): For university examination there shall be a question paper of 70 marks and three hours duration, for each subject. The paper shall be of following nature –PAPER STYLE

Paper No (Code) & Name of Paper; Section: Name of subject (35 Marks)

Q-1. Objective type Question (Multiple Choice/True or False/Short Answer type from all 6 Units(5 out of 6) 05 Mark.

Q-2. Descriptive Questions from Unit 1& 2(2 out of 3) 10 Marks

Q-3. Descriptive Questions from Unit 3& 4 (2 out of 3) 10 Marks

Q-4. Descriptive Questions from Unit 5& 6 (2 out of 3) 10 Marks

iv. Teaching and Examination hours break up:

PAPER NO.	PAPER CODE	TITLE OF THE PAPER/NAME OF THE SUBJECT	TOTAL MARKS			UNIVERSITY EXAM DURATION (HRS)	NO. OF LECTURES (1 HOUR DURATION) PER WEEK
			External	Internal	Total		
1	DMLT 1	Medical Microbiology & Immunology	70	30	100	3	4
		Practical in Medical Microbiology & Immunology	54	24	78	6X2=12	4
2	DMLT 2	Clinical Pathology & Parasitology	70	30	100	3	4
		Practical in Clinical Pathology & Parasitology	52	22	74	6	4
3	DMLT 3	Haematology & Blood Banking	70	30	100	3	4
		Practical in Haematology & Blood Banking	52	22	74	6	4
4	DMLT 4	Fundamentals in Medical Laboratory Technology & Clinical Biochemistry	70	30	100	3	4
		Practical in Fundamentals in Medical Laboratory Technology & Clinical Biochemistry	52	22	74	6	4
Total			490	210	700		32

v. Standard of Passing:

- a. Candidate must obtain 40 % marks in theory papers and practical papers separately.
- b. There will be a separate head of passing for theory papers and practical. If candidate fails in one of the heads, he / she has to reappear only for the failed head.
- c. Training – The candidate has to complete the training in any recognized clinical laboratory or institute or hospital, of a period of minimum 30 days in each of the practical subject.

vi. Qualification of the Examiners:

All examiners on the University panel for theory and practical should have Master degree in the subject/ relevant subject. There will be two examiners (Preferably one internal and one external) for practical examination in each subject.

Introduction:

Medical Laboratory Technology/Medical Technology is the branch of science which deals with all the clinical laboratory investigations on clinical samples for laboratory diagnosis of various diseases. Blood, tissue and body fluids are analyzed and examined for various types of foreign organisms and abnormalities. This information is then used by the medical team to make decisions regarding a patient's medical care. 85% of all medical decisions are based on the results of clinical laboratory investigation reports.

Medical Laboratory Science is an important subject in the field of Medicine. In each system of Medicine, diagnosis of disease is a primary step because no treatment is possible without a proper diagnosis. It is the Medical Laboratory Technocrat, who performs this important task by various scientific tools and techniques. In today's modern world of technology, the diagnosis, treatment & prognosis of various diseases depends upon the results of investigations carried out in a clinical laboratory. Thus, these professionals play a key role in the field of health care. Medical Laboratory Science has played a significant role in the advancement in the field of Medicine, especially in past few decades. As modern medicine becomes more of a team effort, the Medical Laboratory Scientist/Technologist is an important member and integral part of the Medical team.

Definition of Medical Laboratory Technology/Science:

“A medical laboratory professional (also referred to as a Medical Laboratory Technologist, a Clinical Laboratory Scientist or Clinical Laboratory Technologist) is a healthcare professional who performs chemical, hematological, immunologic, microscopic and microbiological diagnostic analyses on body fluids such as blood, urine, sputum, stool, cerebrospinal fluid (CSF), peritoneal fluid, pericardial fluid, and synovial fluid, as well as other specimens. Medical laboratory scientists work in clinical laboratories at hospitals, reference laboratories, biotechnology laboratories and non-clinical industrial labs.”

Education of the medical laboratory professional

When developing any education programme, it is necessary that programme planning should be outcome-based and should meet local and national manpower requirements. It should also provide personal satisfaction and career potential for the professionals with supporting pathway in the development of the profession. One of the major changes is the shift from a focus based on traditional theoretical knowledge, to a skills-and competencies-based education and training. Optimal education/training requires that the student is able to integrate knowledge, skills and attitude in order to be able to perform a professional act adequately in a given situation. Thus, the following curriculum is prescriptive, aims to focus on a skills-and competencies-based approach for learning and is designed accordingly to standardize the content across the nation.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
REVISED SYLLABUS FOR P.G.DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY
SUBJECT CODE: DMLT 1: PAPER – I: MEDICAL MICROBIOLOGY &
IMMUNOLOGY
SECTION – I: MEDICAL MICROBIOLOGY

Rationale: The Medical Microbiology course has been formulated to impart basic and medically relevant information on the microbes. The microbial structure, growth and development, methods and role of sterilization in the context of study of microbes are included. The pathogenic microbes and the diseases caused by them are included to broaden the perspective of the subject. This course will also focus on mechanisms of microbial pathogenesis and the host response, and the scientific approaches that are used to investigate these processes. Lastly the course deals with the problem of emerging antimicrobial resistance with reference to known pathogens.

Unit	Topics	Content/ Fundamental Concepts
1.	INTRODUCTION TO CLINICAL MICROBIOLOGY	<p>1.1 EVOLUTION AND HISTORY OF MICROBIOLOGY:</p> <ul style="list-style-type: none"> a) Definition b) History c) Discovery of microorganisms d) Contributions of Louis Pasteur and Robert Koch in Medical Microbiology. <p>1.2 CLASSIFICATION OF MICROORGANISMS:</p> <ul style="list-style-type: none"> a) General characteristics of prokaryotes & eukaryotes b) Morphological classification of bacteria c) Introduction to Bacterial cell structures <p>1.3 MICROSCOPY</p> <ul style="list-style-type: none"> a) Introduction and history b) Types of microscopes: Principles & Components <ul style="list-style-type: none"> i. Light microscope ii. Dark field microscope iii. Fluorescent iv. Phase contrast v. Electron microscope: Transmission/ Scanning c) Importance and applications of dyes, stains, fixatives, mordant and intensifiers.

2.	PURE CULTURE STUDY	<p>2.1 Types of media: Principle, composition and use</p> <ol style="list-style-type: none"> a) Nutrient Agar b) Mac Conkey Agar c) Eosin Methylene Agar d) CLED Agar e) W B Agar f) Kings Agar g) MSA h) PSA <p>2.2 Methods of Cultivation</p> <ol style="list-style-type: none"> a) Broth, slant and Stab b) Enrichment technique <p>2.3 Methods of Isolation</p> <p>2.4 Preservation</p>
3.	STERILIZATION AND DISINFECTION	<p>3.1 Sterilization</p> <ol style="list-style-type: none"> a) Introduction and Definition b) Principles and applications <p>3.2 Physical Methods</p> <ol style="list-style-type: none"> a) Heat b) Radiation c) Filtration <p>3.3 Chemical methods</p> <ol style="list-style-type: none"> a) Alcohol b) Phenol & Phenolic compounds c) Hypochlorite d) ETO e) β- propionolactone <p>3.4 Ideal characteristics and mode of action of Disinfectants</p> <p>3.5 Antibiotic susceptibility test by disk diffusion technique</p>
4.	LABORATORY DIAGNOSIS OF INFECTIOUS DISEASES	<p>4.1 Collection, preservation, transport, processing and disposal of following clinical samples for culture</p> <ol style="list-style-type: none"> a) Blood b) Throat c) Sputum d) Pus e) Urine f) Stool g) C.S.F h) Other body fluids
5.	CLINICAL BACTERIOLOGY	<p>5.1 Identification of microorganisms by morphological, cultural and biochemical characteristics</p> <ol style="list-style-type: none"> a) <i>Staphylococcus aureus</i> b) <i>Bacillus cereus</i> c) <i>Escherichia coli</i> d) <i>Klebsiella spp.</i> e) <i>Enterobacter aerogenes</i>

		<p>f) <i>Proteus vulgaris</i> g) <i>Salmonella spp.</i> h) <i>Pseudomonas aeruginosa</i></p> <p>5.2 Pathogenesis and laboratory diagnosis of microbial disease</p> <p>a) TB b) Syphilis c) Diphtheria d) Food poisoning e) Typhoid f) Leptospirosis</p> <p>5.3 Nosocomial Infections</p> <p>5.4 Automation</p> <p>a) BACTEK b) VITEK</p>
6	CLINICAL MYCOLOGY & VIROLOGY	<p>6.1 Mycology</p> <p>a) Introduction of Mycosis b) Morphology of fungi c) Specimen collection & diagnostic methods of fungal infection</p> <p>6.2 Virology: Morphology, Pathogenesis and Laboratory diagnosis of</p> <p>a) Hepatitis b) AIDS c) Dengue d) Chikungunya</p>
<p>REFERENCE BOOKS:</p> <ol style="list-style-type: none"> Godkar P B. Text book of Medical Laboratory Technology, 2nd Edn. 2003 Bhalani Publication. Ananthnarayan R. and Jayram Paniker C.K. Text book of Medical Microbiology, 5th Edn. Orient Longman, Madras. Mackie and McCartney Medical Microbiology. A Guide to Laboratory Diagnosis and control of Infection. 13th ed., J.P. Duguid, B.P. Marmion and R.H.A. Swain, The English Language Book Society and Churchill Company. Cheesbrough Monica, District laboratory practice in tropical countries VOL-1 & 2, Cambridge University Press. Prescott M, Harley John P., Microbiology, 8th edition, Lansing, Donald A. Klein, McGraw Hill. A text book of Microbiology and immunology, 2nd Edition, Subhash Chandra Parija, ELSEVIER, a division of Reed Elsevier India Private Ltd. Modi H.A., Elementary Microbiology, Fundamentals of Microbiology, Vol-1, Akta Prakashan, Nadiad Mukharjee K.L. (1999), <i>Medical Laboratory Technology</i>, Vol II, 2nd ed., Tata MacGraw Hill. 		

SECTION – II: IMMUNOLOGY

Rationale: The students will learn how to analyze various clinical patients samples, for estimation of different components which are the cause of the immune disease or are the diagnostic/prognostic markers. This subject gives information about various clinically important cells of immune system, lymphoid organs, antigen, antibody, Ag-Ab. reactions, transplant immunology etc. & automation techniques.

Unit	Topics	Content/ Fundamental Concepts
1.	IMMUNITY	1.1 Introduction 1.2 Classification of immunity a) Innate immunity b) Acquired immunity c) Active & Passive immunity d) Cell mediated immunity e) Humoral immunity 1.3 Organs and cells of immune system
2.	ANTIGEN & ANTIBODY	2.1 Antigens a) Defination, Characterstics ,Properties of antigen b) Classification of antigens. c) Types of Antigen- Haptens and Epitopes 2.2 Antibodies/ Immunoglobulins a) Defination, Characterstics,properties,Structure & Types of immunoglobulins b) Monoclonal Antibodies and their production c) Polyclonal antibody
3.	ANTIGEN-ANTIBODY REACTION	3.1 Defination, Mechanism and Factors affecting antigen –antibody reactions. 3.2 Principle, procedure and applications of various antigen antibody reactions a) Precipitation b) Agglutination c) Fluorescent – antibody technique d) RIA e) Enzyme linked immunosorbent assay (ELISA) f) Complement fixation test 3.3 Immunochromatograghy
4.	COMPLEMENT & VACCINES	4.1 Introduction, types & functions of complement system. 4.2 Introduction & types of vaccine. 4.3 Vaccination Schedule in India
5.	IMMUNOLOGICAL DISORDER	5.1 Hypersensitivity: Classification and Immunological basis 5.2 Auto-immunity: Mechanisms and classification of auto immune disorders 5.3 Immunodeficiency: Immunological basis of Primary and secondary Immunodeficiency Diseases

6.	ADVANCED DIAGNOSTIC TECHNIQUES	6.1 Blotting Techniques 6.2 Nucleic acid amplification test(NAT) 6.3 Chemiluminescence.
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REFERENCE BOOKS:

1. Ananthnarayan R. and Jayram Paniker C.K. Text book of Medical Microbiology, 5th Edn. Orient Longman, Madras.
2. Godkar P B. Text book of Medical Laboratory Technology, 2nd Edn. 2003 Bhalani Publication.
3. Roitt I.M., Essential Immunology, 6th Edn. ELBS, London
4. Talwar G. P., A Hand book of Practical Immunology, 1st Edn. Vikas Publishing House.
5. Owen, Judith A., Punt Stanford, Sharon A., Jones, Patricia P., Kuby Immunology, 7th ed. Macmillan Higher education Pub.

PRACTICAL BASE ON PAPER-1

SECTION-I: MEDICAL MICROBIOLOGY

1. Study of Compound Microscope.
2. Cleaning, Neutralization and preparation of glassware for sterilization.
3. Examination of living Bacteria.
 - a) Wet mount preparation
 - b) Hanging – drop technique.
 - c) Semisolid stab agar test.
4. (A) Staining of the bacterial cell
 - a) The Simple Stain
 - b) The Negative Stain.
 (B) Differential Staining
 - a) The Gram Stain
 - b) The Acid fast Staining.
 (C) Special Staining
 - a) The Spirocheate Stain
 - b) The Metachromatic Granules Stain.
 - c) The spore Stain
 - d) The Capsule Stain
5. Study of some important biochemical reactions.
 - a) Indole Test.
 - b) Methyl red Test.
 - c) V.P. Test.
 - d) Citrate Utilization Test.
 - e) H₂S Production (2% peptone)
 - f) Study of TSI slants with different
 - g) Fermentation of Sugars
 - h) Test for enzyme activity-Oxidase, Catalase, Coagulase, Urease,
6. Preparation of media, pH adjustment and preparation of buffers
 - (A) Bacteriological Media
 - a) Nutrient agar
 - b) MacConkey' agar
 - c) EMB agar

- d) Wilson & Blair's agar for Salmonella sp.
- e) CLED medium for Urinary Tract Infection.
- f) King's medium for Pseudomonas sp.
- g) Manitol Salt agar for *Staphylococcus* sp.
- (B) Mycological Media
 - a) Potato – dextrose agar.
 - b) Glucose Yeast Extract agar.
 - c) Sabouraud's agar
- 7. Pure culture study of the following cultures.
 - (i) *Bacillus cereus*
 - (ii) *Staphylococcus aureus*
 - (iii) *Escherichia coli*
 - (iv) *Enterobacter aerogenes*(*Klebsiella mobillis*)
 - (v) *Klebseilla pneumoniae*
 - (vi) *Proteus vulgaris*
 - (viii) *Salmonella typhi* / *paratyphi A* / *paratyphi B*
 - (ix) *Pseudomonas aerugenosa*
- 7. Demonstration of common fungi - Penicillin, Aspergillus, Rhizopus, Mucar, Yeast.
- 8. Schematic Processing/Methods of Isolation and identification of aerobic and anaerobic bacteria/pathogens from pathological specimens- Blood; Urine; Stool; Pus; CSF; Sputum; Body Fluid; Ear Swab; Eye Swab; Nasopharyngeal Swab; Throat Swab
- 9. Antimicrobial susceptibility testing by Kirby-Bauer disc diffusion method

SECTION-II: IMMUNOLOGY

Diagnostic tests:

1. ICT/Dot immunoassay/ Flow through assay for HIV Ab
2. ICT/Dot immunoassay/ Flow through assay for HBs Ag
3. ICT/Dot immunoassay/ Flow through assay for HCV Ab
4. Slide / Tube/ Strip / Cassette, Dot immunoassay test for typhoid
5. Slide test for syphilis/Flow through /Spot/ Immunodot for Syphillis
7. Slide / Strip / Cassette test for Pregnancy
8. Latex test for Rheumatoid arthritis
9. Latex test for C-Reactive protein
10. Latex test for Anti Streptolysin O (ASO).
11. Leptospirosis ICT (Demonstration)
12. Chickungunya ICT (IgG,IgM) (Demonstration)

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
 REVISED SYLLABUS FOR P.G.DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY
**SUBJECT CODE: DMLT 2: PAPER – II: CLINICAL PATHOLOGY &
 PARASITOLOGY**
SECTION – I: CLINICAL PATHOLOGY

Rationale: The candidates are imparted basic training of theoretical and practical in the field of clinical pathology. The training in this subject enables the students to carry out routine clinical laboratory

investigation (urine, stool, sputum etc.). The candidates are made to learn collection of clinical samples and their processing along with basic histopathological technique and recording of data.

Unit	Topics	Content/ Fundamental Concepts
1.	URINE ANALYSIS	1.1 Formation of urine and its composition 1.2 Indications, Collection, Preservation & Transportation of Urine specimen. 1.3 Routine Examination -Physical, Chemical & Microscopic. 1.4 Correlation of urinary findings in various diseases. 1.5 Automated Urine Analysis & Reagent Strip Method 1.6 Pregnancy Test
2.	STOOL ANALYSIS	2.1 Indication, Collection, Preservation, Transportation of stool 2.2 Routine - Physical, Chemical & Microscopic Examination of stool 2.3 Significance of presence of blood and excess fat in stool. 2.4 Occult blood – Detection 2.5 Concentration methods for detection of intestinal parasites
3.	SEMEN ANALYSIS	3.1 Formation of semen 3.2 Indication, Collection, Preservation, Transportation of semen specimen 3.3 Physical, Chemical & Microscopic Examination as per WHO Recommendation. 3.4 Medico – legal significance of Semen examination.
4.	CEREBROSPINAL FLUID	4.1 Formation of C.S.F. 4.2 Composition of CSF. 4.3 Collection, Preservation & Transportation of C.S.F. 4.4 Physical, Chemical & Microscopic Examination. 4.5 Correlation of Abnormal C.S.F. findings in various diseases.
5.	EXAMINATION OF BODY FLUIDS & SPUTUM	Formation ,Composition, Indications, Significance, Collection, Preservation, Transport and Routine Examination of 5.1 Pleural 5.2 Peritoneal 5.3 Pericardial 5.4 Synovial fluid 5.5 Gastric Juice 5.6 Sputum
6.	HISTOPATHOLOGY TECHNIQUES	6.1 Introduction to Histotechnology 6.2 Types of fixatives uses. 6.3 Decalcification 6.4 Basic concept of tissue processing. 6.5 Microtomy & Types of Microtome 6.6 Principle & Procedure of Staining techniques: H &E, PAP 6.7 Automated tissue processing 6.8 Museum- Technique & Specimen preservation. 6.9 FNAC

REFERENCE BOOKS:

1. Godkar P. B. (2014). *Textbook of Medical Laboratory Technology*, 3rd ed., Bhalani Publishing house.
2. Ochei J. & Kolhatkar A. 2000, *Medical Laboratory Science: Theory & Practice*, Tata McGraw Hill Pub.
3. Mukharjee K.L. (1999), *Medical Laboratory Technology*, Vol II, 2nd ed., Tata MacGraw Hill.
4. Mohan H. (2005). *Textbook of Pathology*, 5th ed., Jaypee Brothers Medical publishers (P) LTD.
5. Sood R. (1994) *Medical Laboratory Technology*, 4th ed., Jaypee Brothers.
6. Kawthalkar S M, *Essential of Clinical Pathology*, 2nd ed., Jaypee Brothers.

SECTION – II: PARASITOLOGY

Rationale: The candidates undergoing training medical laboratory technology are made to learn the techniques of collection of samples, their processing and identification of various parasitic pathogens, using different procedures with special reference to their habitat, morphology, life cycle and their isolation, identification for diagnostic purpose.

Unit	Topics	Content/ Fundamental Concepts
1.	GENERAL PARASITOLOGY	1.1 Introduction to Medical Parasitology with respect to terms used in Parasitology 1.2 General characteristics and Classification of Parasite 1.3 Types of Parasite and Types of Host 1.4 Host –Parasite Relationship 1.5 Mode of transmission 1.6 Laboratory Diagnosis of Parasitic Infection
2.	PROTOZOOLOGY I	Morphology, Life cycle, Mode of infection and Laboratory diagnosis 2.1 <i>Entamoeba histolytica</i> 2.2 <i>Trichomonas vaginalis</i> 2.3 <i>Naegleria fowleri</i> 2.4 <i>Acanthamoeba</i> species
3.	PROTOZOOLOGY II	Morphology, Life cycle, Mode of infection and Laboratory diagnosis 3.1 <i>Leishmania donovani</i> 3.2 <i>Giardia lamblia</i> 3.3 <i>Plasmodium falciparum</i> & <i>Plasmodium vivax</i> 3.4 <i>Toxoplasma gondii</i>
4.	CESTODES	Morphology, Life cycle, Mode of infection and Laboratory diagnosis 4.1 General characteristics of Cestodes 4.2 <i>Taenia saginata</i> 4.3 <i>Taenia solium</i> 4.4 <i>Echinococcus granulosus</i>
5	TREMATODES	Morphology, Life cycle, Mode of infection and Laboratory diagnosis 5.1 General characteristics of Trematodes 5.2 <i>Schistosoma haematobium</i> 5.3 <i>Schistosoma mansoni</i> 5.4 <i>Schistosoma japonicum</i>
6	NEMATODES	Morphology, Life cycle, Mode of Transmission and Laboratory diagnosis 6.1 General characteristics of Nematodes 6.2 <i>Trichuris trichiura</i>

	6.3	<i>Strongiloides stercoralis</i>
	6.4	<i>Anchylostoma duodenale</i>
	6.5	<i>Enterobius vermicularis</i>
	6.6	<i>Ascaris lumbricoides</i>
	6.7	<i>Wuchereria bancrofti</i> and <i>Brugia malayi</i> .

REFERENCE BOOKS:

1. Chatterjee K.D. (2009). *Parastology: Protozoology and Helthminthology in Relation to Clinical Medicine*, 13th ed., CBC Publishers & Distributors Pvt Ltd
2. Arora D.R. and Arora B. (2004). *Medical Parasitology*, 2nd ed., CBC Publishers & Distributors Pvt Ltd.
3. Godkar P. B. (2014). *Textbook of Medical Laboratory Technology*, 3rd ed., Bhalani Publishing house.
4. Ichhpujani RL and Bhatia Rajesh. *Medical parasitology*.3rd ed., JP
5. Chakraborty P. *Text book of Medical Parasitology*, 2nd ed., JP

PRACTICAL BASE ON PAPER-II

SECTION-I:CLINICAL PATHOLOGY

1. Routine Urine Analysis: Physical, Chemical, Microscopic examination & Reagent Strip Method
2. Routine Stool Analysis: Physical, Chemical, Microscopic examination.
3. Routine Cerebrospinal Fluid Analysis: Physical, Chemical, Microscopic examination.
4. Routine Sputum examination: Physical, Microscopic
5. Routine Gastric Juice Analysis: Chemical examination of gastric juice.
6. Routine Semen Analysis: Physical, Chemical, Microscopic examination.
7. Routine Body fluids - Peritoneal, Pleural, Pericardial, Synovial (each separately): Physical, Chemical, Microscopic examination.
8. Cutting, Fixation and processing of tissues (Demonstration).
Staining – (i) Haematoxylin and Eosin for paraffin sections.
(ii) PAP Stain for cytology.

SECTION-II:PARASITOLOGY

- 1 Routine stool examination for detection of intestinal parasites with concentration methods: (Demonstration)
 - a) Saline preparation
 - b) Iodine preparation
 - c) Flootation method
 - d) Centrifugation method
 - e) Formal ether method
 - f) Zinc sulphate method
2. Identification of adult worms, Tapeworm segments ,ova, cysts, and larvae of parasite from charts/photographs/models/slides
3. Malarial Parasite Microscopy:
 - i. Preparation of thin and thick blood smears
 - ii. Staining of smears
 - iii. Examination of smears for malarial parasites (*P. vivax* and *P. falciparum*)
 - iv. Demonstration of various stages of life cycle of malarial parasites from stained slides
4. Malaria Rapid diagnostic test (RDT/ICT)

REVISED SYLLABUS FOR P.G.DIPLOMA OF MEDICAL LABORATORY TECHNOLOGY
SUBJECT CODE: DMLT 3: PAPER – III: HAEMATOLOGY & BLOOD BANKING
SECTION – I HAEMATOLOGY

Rationale: The training in this subject is imparted to enable the students to carry out routine clinical laboratory investigation in haematology or related to blood. They should be able to provide technical help for selected sophisticated hematological techniques with adequate knowledge of various principles.

Unit	Topics	Content/ Fundamental Concepts
1.	INTRODUCTION TO HAEMATOLOGY	1.1 Definition, composition and functions of blood. 1.2 Collection & Storage of blood :venous and capillary. 1.3 Various equipment used for collection of blood samples 1.4 Anticoagulants: Definition and various types along with their mode of action, uses, methods of preparation merits and demerits of each. 1.5 Formation of blood: Erythropoiesis, Leucopoiesis, Thrombopoiesis.
2.	HAEMOGLOBIN & HAEMOGLOBIN OPATHIES	2.1 Definition, types, structure of Hb 2.2 Hb Estimation: Different methods-(a) Colorimetric Method, (b) Sahli's Method, and (c) Specific Gravity Method. 2.3 Clinical importance, Normal ,abnormal values and Physiological variations 2.4 Haemoglobinopathies: Abnormalities of Haemoglobin Molecule. Sickle Cell Anaemia &Thalassemia 2.5 Tests for Haemoglobinopathies: Screening test : Sickling test, DTT, NESTROF Confirmative test: Electrophoresis & HPLC
3.	RED BLOOD CELLS & ANAEMIAS	3.1 RBC count: Normal, abnormal values, and Physiological variations 3.2 Morphology of normal and abnormal Red Blood Cells. 3.3 Reticulocyte count 3.4 Erythrocyte Sedimentation Rate (ESR), 3.5 Haematocrit: Pack Cell Volume(PCV) and Various Blood indices; their brief description 3.6 Anemia: Definition and classification of anemia; factor causing anemia a) Iron & B-12 deficiency anaemia. b) Aplastic anaemia c) Haemolytic anaemia & Sideroblastic anaemia. d) G-6PD deficiency anaemia.
4.	WHITE BLOOD CELLS & LEUKAEMIAS	4.1 Total White Blood Cell Count : Normal and abnormal values 4.2 Differential WBC Count :- Normal, abnormal values and physiological variation; Preparation of peripheral blood smear, Staining by different methods. 4.3 Introduction and general Classification of Leukaemias. Acute & Chronic Myeloid Leukaemias.

5.	HAEMOSTASIS & BLOOD COAGULATION	5.1 Coagulation Factors, Mechanism of Blood Coagulation. 5.2 Coagulation disorders, Haemophilia A & Haemophilia B 5.3 Platelet disorders and Platelet count. 5.4 Coagulation defect test – a) Bleeding time (BT), b) Clotting time(CT), c) Prothrombin time (PT), d) Activated Partial Thrombo Plastin time (APTT), e) Thrombin time f) Fibrinogen g) D- dimer h) Fibrin degradation product.
6.	AUTOMATION & QUALITY CONTROL IN HEMATOLOGY	6.1 Basic concepts of automation in Haematology with special reference to: a) Blood cell counter b) Coagulometer 6.2 Quality control in Hematology.

REFERENCE BOOKS:

1. Godkar P.B, Textbook of MLT, 3rd edition, Bhalani Publications.
2. Mukherjee .L. K , Medical Laboratory Technology, Vol.1-3, 3rd edition, Tata McGraw Hill
3. Wintrobe’s Clinical Haematology, 14th edition, Lippincott Williams & Wilkins
4. De Gruchy’s Clinical Haematology in Medical Practice, Sixth edition, Wiley Publications
5. Sood Ramnik, Text book of Medical Laboratory Technology, 5th edition, Jaypee Publications
6. Dacie & Lewis Practical Haematology, 12th edition, Elsevier Publications
7. Kawthalkar S M, Essential of Clinical Pathology, 2nd ed., Jaypee Brothers.

SECTION – II: BLOOD BANKING

Rationale: The candidates are taught the skill of blood collection from donors and preventive measures against communicable diseases. They should be able to perform different investigations, preservation and interpretation.

Unit	Topics	Content/ Fundamental Concepts
1.	BLOOD GROUP SYSTEM –I & II	1.1 ABO blood Group system, subgroup of ABO, Variants of ABO blood group system. 1.2 Rh blood group system. 1.3 Serological techniques for detection of ABO & Rh antigens. 1.4 Gel technique for blood grouping and serological Techniques. 1.5 AHG test. 1.6 Other Blood Group systems 1.7 Importance of Atypical antibodies, their detection and clinical significance
2.	BLOOD COLLECTION & COMPONENT PREPARATION	2.1 Screening of Donor 2.2 Phlebotomy of Blood Donor 2.3 Storage and transportation of blood 2.4 Mandatory screening tests-HIV1&HIV2, HBsAg, HCV, RPR & Malaria.

		<p>2.5 Component preparation:</p> <ol style="list-style-type: none"> Red cell concentrate Fresh Frozen Plasma Cryoprecipitate Platelet concentrate <p>2.6 Introduction of apheresis and Single donor platelet (SDP)</p>
3.	COMPATIBILITY TESTING AND ISSUE OF BLOOD FOR TRANSFUSION	<p>3.1 Compatibility testing and special methods of routine and emergency cross match</p> <p>3.2 Problems and Trouble shooting in grouping and Cross matching</p> <p>3.3 Discrepancies in ABO grouping</p> <p>3.4 Selection of Blood/Blood Components for Transfusion</p>
4.	TRANSFUSION REACTION AND HDN	<p>4.1 Types of Transfusion reaction</p> <p>4.2 Investigation of Transfusion reaction.</p> <p>4.3 Hemolytic disease of Newborn due to ABO, Rh or Other blood group incompatibility</p>
5.	AUTOMATION AND BIOSAFETY IN BLOOD BANKING	<p>5.1 Automation in Blood collection</p> <p>5.2 Automation in blood grouping , Cross matching</p> <p>5.2 Bio safety and Biomedical waste management</p>
6.	QUALITY CONTROL IN BLOOD BANKING	<p>6.1 QC of reagents-Parameters, Quality Requirements and frequency</p> <p>6.2 QC of Blood Components- Parameters, Quality Requirements and frequency</p>

REFERENCE BOOKS:

- Denise Harmening ,Modern Blood banking and Transfusion Practices, 6th Edition 2012.
- Saran RK., Transfusion Medicine Technical Manual, ed, 2nd ed, Directorate General of Health Service (DGHS), Ministry of Health & Family Welfare, 2003.
- Mollison PL,Engelfriet CP and Marcela Contreras: Blood Transfusion in Clinical Medicine. 12th edition, Blackwell Science, 2014
- Makroo R.N., Compendium of Transfusion Medicine, Practice of Safe Blood Transfusion,
- Technical Manual, American Association of Blood Banks, 1996.
- Technical Manual, American Association of Blood Banks, 2014
- Wintrobe.M.M.,Clinical Haematology, Kothari's Indian Edition.
- Dacei J.A & Lewis S.M. Practical Haematology. The English Language Book Society. 8th ed., ELBS
- Mark K Fung, Brenda J. Grossman, Christopher D. Hillyer, Connie M Westhoff. Technical Manual. 18th ed.,AABB

PRACTICAL BASED ON PAPER III

SECTION-I:HAEMATOLOGY

- Methods of Blood Collection and Anticoagulants
- Haemoglobin estimation: Sahli's method and Cyanmethaemoglobin method.
- Total R.B.C.
- Total W.B.C. Count.

5. Differential Count.
6. Platelet Count.
7. Reticulocyte Count
8. E.S.R.
9. Packed cell volume/ Determination of Haematocrit.
10. Bleeding time, Whole Blood Coagulation time and Prothrombin time.
11. Osmotic fragility test –single tube test.
12. Sickling test.- Slide Test, Solubility Test

SECTION – II : BLOOD BANKING.

1. ABO (Forward) and RH grouping by slide method.
2. ABO (Forward) and RH grouping by Tube method.
3. ABO Reverse grouping
4. Direct Antiglobulin Test (DAT)
5. Indirect antiglobulin test (IAT)
6. Tests for Weak D testing by albumin and indirect antiglobulin technique
7. Anti A/ Anti B titer
8. Anti D titration by albumin and indirect antiglobulin technique
9. Cross matching by saline, albumin and IAT
10. Test for HBsAg (Hepatitis B surface Antigen) ELISA and Rapid Test.
11. Test for HIV / HCV Antibodies (ELISA and Rapid Test)
12. Visit to a Blood Bank.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
REVISED SYLLABUS FOR P.G.DIPLOMA OF MEDICAL LABORATORY TECHNOLOGY
SUBJECT CODE: DMLT 4: PAPER – IV: FUNDAMENTALS IN MEDICAL
LABORATORY TECHNOLOGY & CLINICAL BIOCHEMISTRY
SECTION – I: FUNDAMENTALS IN MEDICAL LABORATORY TECHNOLOGY

Rationale: The main objective of the subject is to impart the knowledge of apparatus, units, equipment, and volumetric analysis in the laboratory of clinical Biochemistry. The students are also given basic training in safety measures quality control and automation.

Unit	Topics	Content/ Fundamental Concepts
1.	BASICS OF CLINICAL LABORATORY	1.1 Introduction to Medical Laboratory Technology a) Role of Medical lab Technologist b) Ethics and responsibility 1.2 Safety measures for Mechanical, Electrical, Chemical, Radioactive and Biological hazards; Universal safety precautions. 1.3 First aid 1.4 Units of Measurements 1.5 Reagent Grade Water 1.6 Types and Preparation of Solutions 1.7 Acid, Base, p ^H , Indicators, Buffer and Buffering action 1.8 Introduction to laboratory accreditation (NABL)

2.	LABORATORY INSTRUMENTS- I	Principle, Component, Operations , Maintenance and Applications of 2.1 Balance 2.2 P ^H Meter 2.3 Centrifuge 2.4 Water Distillation Apparatus
3.	LABORATORY INSTRUMENTS- II	Principle, Component, Operations , Maintenance and Applications of 3.1 Colorimeter 3.2 Spectrophotometer 3.3 Flame Photometer 3.4 Turbidimeter
4.	ELECTROPHORESIS & CHROMATOGRAPHY	4.1 Electrophoresis: a) Principle b) Factors Affecting Electrophoresis c) Support Media d) Types Of Electrophoresis: PAGE & SDS 4.2 Chromatography a) Principle b) Types c) Applications
5.	AUTOMATION IN BIOCHEMISTRY	5.1 Types Of Biochemistry Analyzer a) Continuous Flow Analysers b) Discrete Chemistry Analysers c) Centrifugal Analysers d) Dry Chemistry Analysers 5.2 Advantages and Disadvantages Of Automation 5.3 Blood Gas Analysers
6.	QUALITY CONTROL	6.1 Analytical Variables: a) Accuracy, Precision and Reliability b) Standard and Control c) Sensitivity and Specificity d) Types of Error e) Mean, Standard Deviation, Co-Efficient Of Variation and Central Tendency 6.2 Internal and External Quality Control 6.3 Preparation Of Quality Control Charts a) Levy-Jenning Chart and Gaussian Curve b) Cusum Chart 6.4 Westgard Multirule Chart 6.5 Various Ways of Maintaining Quality Control

REFERENCE BOOK

1. P.B. Godkar, 2014, *Textbook of Medical Laboratory Technology*, 3rd ed., Bhalani Publishing House, Mumbai, India.
2. Ochei J. & Kolhatkar A. 2000, *Medical Laboratory Science: Theory & Practice*, Tata McGraw Hill Pub.
3. Wilson K. & Walker J., *Practical Biochemistry: Principles & Technique*, 5 ed., Cambridge University Press.
4. Tambwekar S., *Handbook of Quality Assurance in Laboratory medicine.*, BI
5. Veerakumari L., *Bio Instrumentation.*, MJP

SECTION – II CLINICAL BIOCHEMISTRY

Rationale: The candidates are imparted specialized training of theory and practical in the field of clinical biochemistry. The students will learn how to analyze various clinical patients samples, for estimation of different components which are the cause of the disease or are the diagnostic/prognostic markers. This subject gives information about various clinically important enzymes & learn special biochemical investigations e.g. LFT, RFT, etc.

Unit	Topics	Content/ Fundamental Concepts
1.	CARBOHYDRATES	1.1 Definition, Classification, Functions of Carbohydrates. 1.2 Digestion, absorption of Carbohydrates. 1.3 Regulation of blood glucose & its importance, 1.4 Hyperglycemia, Hypoglycemia 1.5 Diabetes & Diabetic Profile. 1.6 Blood Glucose estimation & Glucose Tolerance Test Glucocylated Hb
2.	PLASMA PROTEINS	2.1 Definition, Classification , Functions of Plasma Proteins 2.3 Plasma Proteins estimations. 2.4 Clinical significance plasma protein; Bence-Jones' Proteins and Cryoglobulins.
3.	LIPIDS AND LIPOPROTEINS	3.1 Lipid: Definition, Classification , Functions, Essential Fatty Acids 3.2 Lipoproteins: Classification and its Separation methods 3.3 Important Lipid Profile Tests- cholesterol, triglyceride, Lipoproteins, phospholipids and its significance in various disorders.
4.	CLINICAL ENZYMOLOGY AND ENDOCRINOLOGY	4.1 Definition, Classification, Factors affecting enzyme activity, Isoenzymes and Coenzymes. 4.2 Clinical Enzymology: Therapeutic, diagnostic and analytical uses of enzymes 4.3 Estimation Methods and Diagnostic Importance of Enzymes & Isoenzymes: a) Phosphatases b) Transaminases c) Lactate Dehydrogenases d) Creatine Kinase e) Amylase

		f) Lipase g) Gama Glutamyl Transferase 4.4 HORMONES: a) Types and biochemical functions. b) Determination of T3, T4, TSH.
5.	FUNCTION TESTS	5.1 Liver Function Tests 5.2 Renal Function Tests 5.3 Cardiac Function Tests
6.	ELECTROLYTES AND VITAMINS	6.1 Minerals and Electrolytes determination and clinical Significance a) Sodium b) Potassium c) Chloride d) Calcium e) Phosphorus f) Iron & TIBC 6.2 Vitamins a) Brief Classification and Clinical Significance b) Determination of Vitamin B ₁₂ and D ₃ .

REFERENCE BOOK

1. P.B. Godkar, 2014, *Textbook of Medical Laboratory Technology*, 3rd ed., Bhalani Publishing House, Mumbai, India.
2. Ochei J. & Kolhatkar A. 2000, *Medical Laboratory Science: Theory & Practice*, Tata McGraw Hill Pub.
3. Wilson K. & Walker J., *Practical Biochemistry: Principles & Technique*, 5 ed., Cambridge University Press.
4. Chatterjea M. N. and Shinde R. 2007. *Textbook of Medical Biochemistry*, 8th ed., Jaypee Brothers Publishers.
5. Vasudevan D. & Sreekumari S. 2005. *Textbook of Biochemistry*; 4th ed, Jaypee Publishers.
6. Harold Varley, 1990, *Practical Clinical Biochemistry*, Indian Edition, Anold Heinemann.
7. Satyanarayan, U. Chakrapani, Biochemistry, 3rd edition, Books & Allied Pvt Ltd Kolkatta.

PRACTICAL BASED ON PAPER IV

SECTION – I : FUNDAMENTALS IN MEDICAL LABORATORY TECHNOLOGY

1. Operation of - pH meter, Single pan Balance, Spectrophotometer, Colorimeter, Autoanalyzer, Centrifuge.

SECTION – II : CLINICAL BIOCHEMISTRY

Preferably all the test should be done on semi Auto analyser.

1. Blood Glucose/Sugar estimation and GTT.
2. Blood Cholesterol – Free & Total HDL Cholesterol, LDL Cholesterol.
3. Serum Triglyceride
4. Serum Total Protein and Serum Albumin and A/G ratio
5. Microalbumin test
6. Blood/Urine Urea.
7. Blood /Urine Creatinine.
8. Blood /Urine Uric Acid
9. Serum Calcium / Ionized Calcium

10. Serum Phosphorus
11. Serum Potassium
12. Serum Sodium
13. Serum Chloride
14. Serum Iron, and TIBC (Total Iron Binding Capacity)
15. Serum Bilirubin.
16. Serum Alkaline Phosphatase.
17. Serum Acid Phosphatase.
18. S.G.O.T
19. S.G.P.T.
20. LDH
21. CPK
22. Serum Amylase.
23. Serum Lipase
24. Serum Protein Electrophoresis and Lipoprotein electrophoresis (Demonstration).
25. Cardiac Troponin T (Demonstration)
26. Cardiac Troponin I (Demonstration)
27. T3 ,T4, TSH ELISA (Demonstration)

File



Re-Accredited N 2 & 3 CPA by NAAC

VEER NARMAD SOUTH GUJARAT UNIVERSITY

University Campus, Uthana Mangrulla Road, SURAT - 395 007, Gujarat, India

વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી

યુનિવર્સિટી કૅમ્પસ, ઉથના મંગરુલા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.

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E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

--: પરિપત્ર :-

તા. ૧૯-૦૬-૨૦૧૪
વિભાગ કુલ્યાણ

વિજ્ઞાન વિદ્યાશાખા હેઠળની પીજીડીએમએલટીનો અભ્યાસક્રમ ચલાવતી સંલગ્ન કોલેજોના આચાર્યશ્રીઓને જણાવવાનું કે, પીજીડીએમએલટીનો અભ્યાસક્રમ રીવાઈઝડ કરવા અને મેડીકલ ટેકનોલોજી વિષયની અભ્યાસક્રમિતિએ તેની તા. ૧૫-૦૫-૨૦૧૪ ની સભાના દરમિયાન ક્રમાંક : ૩ અન્વયે સ્વીકૃતિ મેળવી ભલામણ વિજ્ઞાન વિદ્યાશાખાએ તેની તા. ૦૩-૦૬-૨૦૧૪ ની સભાના દરમિયાન ક્રમાંક : ૮ અન્વયે સ્વીકૃતિ છે, જે એકેડેમિક કાઉન્સિલે તેની તા.૦૬-૦૬-૨૦૧૪ ની સભાના દરમિયાન ક્રમાંક : ૬૪ અન્વયે મંજૂર કરેલ હોય તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી. તદઉપરાંત તેના અમલ કરવો.

મેડીકલ ટેકનોલોજી વિષયની અભ્યાસક્રમિતિની તા. ૧૫-૦૫-૨૦૧૪ ની સભાની ભલામણ

ક્રમાંક : ૩

:: આથી દરમિયાનમાં આવે છે કે, પીજીડીએમએલટી નો રીવાઈઝડ અભ્યાસક્રમ શૈક્ષણિક વર્ષ ૨૦૧૪-૧૫ થી અમલમાં આવે તે રીતે સ્વીકારવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા. ૦૩-૦૬-૨૦૧૪ ની સભાની ભલામણ ક્રમાંક : ૮

:: આથી દરમિયાનમાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૧૪-૧૫ થી અમલમાં આવનાર પીજીડીએમએલટી નો રીવાઈઝડ અભ્યાસક્રમ સ્વીકારી તે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા. ૦૬-૦૬-૨૦૧૪ ની સભાનો દરમિયાન ક્રમાંક : ૬૪

:: આથી દરમિયાનમાં આવે છે કે, વિજ્ઞાન વિદ્યાશાખાની તા. ૦૩-૦૬-૨૦૧૪ ની સભાના ભલામણ ક્રમાંક : ૮ અન્વયે કરેલ ભલામણ યથાવત સ્વીકારી મંજૂર કરવામાં આવે છે.

વિભાગ : ઉપર મુજબ

ક્રમાંક : એકે./પરિપત્ર/૦૦૫૪/૧૪

તા. ૧૯-૦૬-૨૦૧૪

[Signature]
કુલ્યાણવિવરણી

પ્રતિ,
૧) કુલ્યાણ
૨) પરીક્ષા નિયામકશ્રી,
૩) અનુસ્નાતક વિભાગ,
૪) વીર નર્મદ દ. ગુ. યુનિવર્સિટી,
૫) સુરત.

૧) પીજીડીએમએલટીનો અભ્યાસક્રમ ચલાવતી સંલગ્ન કોલેજોના આચાર્યશ્રીઓ
૨) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
૩) અનુસ્નાતક વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
...તરફ જાણ તેમજ ઘટતી કાર્યવાહી સારૂ.

Translated from Gujarati to English for the purpose of NAAC only

Circular

No. AK/Circular/7054/14

Date: 19/06/2014

The principals of the affiliated colleges offering the PGDMLT under the faculty of science are hereby informed about the revision of the PGDMLT syllabus in the meeting of the board of study of PGDMLT held on 15/05/2014. The following recommendations through the resolution No 3 done by meeting has been accepted by the science faculty through the resolution No. 8 held on 03/06/2014. The finally it was approved by resolution no 64 in meeting of academic council on 06/06/2014. The report it to the concerned teachers and students, and implement it.

Resolution No.: 2, Academic Council of Medical Technology dated 15/05/2014:

Therefore, it is resolved that the recommendation to the Faculty of Science for the approval of the revised syllabus of PGDMLT to accept and allow it to implement from the academic year 2014-2015

Resolution No.: 8, Academic Council of Faculty of Science dated 03/06/2014:

Therefore, it is resolved that the recommendation to the Academic Council for the approval of revised syllabus of PGDMLT to accept and allow it to implement from the academic year 2014-2015

Resolution No.: 64, Academic Council dated 06/06/2014:

Therefore, it is resolved that the recommendation has been approved as per the recommendation under the Resolution No.:8 of Academic Council of Faculty of Science dated 03/06/2014

Attachment: As above

No. : A.C./Circular/7054/14

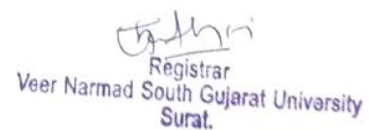
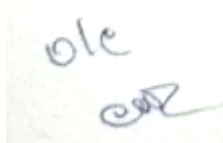
Date: 19/06/2014

Registrar

To,

1. The Principals of affiliated colleges offering P.G.D.M.L.T Course
2. Exam Superintendent, Veer Narmad South Gujarat University, Surat.
3. Post Graduate Department, Veer Narmad South Gujarat University, Surat.

...For Information and Initiation of Appropriate Actions



VEER NARMAD SOUTH GUJARAT UNIVERSITY,

SURAT

SYLLABUS OF DIPLOMA IN MEDICAL TECHNOLOGY (EFFECTIVE FROM JULY- 2014)

Diploma in Medical Technology is a one year Post-Graduate (Post B.Sc.) course. A student offering this course will study Papers I, II, III, IV & practicals based on these papers.

The teaching per week for 4 papers is 16 hours & there are 16 hours per week for practicals.

The total marks of papers are 280 for University examination, distributed as 70 of each paper of 3 hours duration & the internal evaluation is of 120 marks distributed as 30 of each paper. The total marks of practicals are 210 for University examination, distributed as 54 for practical paper-I & practicals papers II, III, & IV are each of 52 marks. The internal evaluation for practical is of 90 marks distributed as 24, 22, 22, & 22 for practical based on Paper I, II, III & IV respectively. The University examination for practicals based on paper I is of 12 hours distributed over a period of 2 days & for practicals based on paper II, III, & IV are of one day each & 6 hours per day.

**VEER NARMAD SOUTH GUJARAT
UNIVERSITY,
SURAT**

**P.G. DIPLOMA IN MEDICAL TECHNOLOGY
Teaching and Examination Scheme**

Paper	Teaching Schedule Hrs./Wk	University Exam Theory/Practical		Internal Exam Theory/Practical Marks	Total marks Theory/Practical
		Duration (hrs)	Marks		
Theory					
Paper I: Microbiology and Immunology	4	3	70	30	100
Paper II: Clinical Pathology and Parasitology	4	3	70	30	100
Paper III: Haematology and Blood Banking	4	3	70	30	100
Paper IV: Clinical Biochemistry	4	3	70	30	100
Practical					
Paper I: Microbiology and Immunology	4	12	54	24	78
Paper II: Clinical Pathology and Parasitology	4	6	52	22	74
Paper III: Haematology and Blood Banking	4	6	52	22	74
Paper IV: Clinical Biochemistry	4	6	52	22	74
TOTAL	32		490	210	700

**VEER NARMAD SOUTH GUJARAT UNIVERSITY,
SURAT**

**REVISED SYLLABUS FOR P.G.DIPLOMA OF MEDICAL
TECHNOLOGY**

(EFFECTIVE FROM JULY-2014)

PAPER - I MICROBIOLOGY & IMMUNOLOGY

SECTION – I MICROBIOLOGY

1. EVOLUTION AND HISTORY OF MICROBIOLOGY:

a. Introduction and brief history of Microbiology.

b. Contribution of following in Medical Microbiology

- i) Leeuwenhoek
- ii) Louis Pasteur
- iii) Robert Koch
- iv) Edward Jenner
- v) Lord Lister
- vi) Paul Ehrlich
- vii) Domagk
- viii) Alexander Flemming
- ix) Elie Metchnikoff

2. CLASSIFICATION OF MICROORGANISMS:

Introduction –

- i) Microorganism,
- ii) Groups of microorganism
- iii) Place of microorganism in living world.
- iv) Difference between Prokaryotes and Eukaryotes.
- v) The world of bacteria- significance of Bergey's Manual.

3. MICROSCOPIC EXAMINATION OF MICROORGANISMS:

a. Introduction and use of Microscope in the study of Bacteria

- i) Light microscope and Electron microscope
- ii) Bright field microscopy
- iii) Dark field microscopy
- iv) Fluorescence microscopy
- v) Phase Contrast microscopy
- vi) Electron microscopy

b. Preparation of microorganism for light microscopic examination

- a) Wet Mount
- b) Hanging drop techniques
- c) Staining of Bacteria:
 1. Composition and Preparation of Staining
 2. Principle and Procedure of Bacteriological stain
 - i. Simple staining
 - ii. Gram staining
 - iii. Acid fast staining

- iv. Metachromatic granules staining
- v. Negative staining
- vi. Spirochete staining
- vii. Capsule staining
- viii. Spore staining

4. CULTIVATION OF BACTERIA:

- i) Nutritional requirements
- ii) Nutritional types of bacteria
- iii) Bacteriological media
- iv) Physical condition for growth
- v) Classification and choice of media
- vi) Conditions of incubation (Both for aerobic and anaerobic cultures)

5. PURE CULTURES AND CULTURAL CHARACTERISTICS:

Introduction -

- i) Pure culture and mixed culture.
- ii) Methods of isolation of pure culture,
- iii) Maintenance and preservation of pure culture.
- iv) Culture characteristics –
 - i. Growth on agar slants,
 - ii. Growth in broth,
 - iii. Growth in stabs;
 - iv. Colony characteristics, Growth characteristics.

6. STERILIZATION AND DISINFECTION:

- a. Introduction and definition of the terms:
 - i) Sterilization,
 - ii) Disinfection and Disinfectant,
 - iii) Antiseptic, sanitizer,
 - iv) Germicide,
 - v) Bactericide,
 - vi) Bacteriostasis,
 - vii) Sepsis
 - viii) Asepsis and Antimicrobial agent.
- b. Factors affecting sterilization and disinfection.
 - i) Sterilization Methods- by heat, chemicals, radiation and filtration.
 - ii) Characteristic of ideal disinfectant.
 - iii) Major group of chemical agents as disinfectants.

7. BACTERIA OF MEDICAL IMPORTANCE:

Classification, antigenic structure, pathogenicity, diseases caused, isolation, characterization-Morphology, cultivation and laboratory diagnosis including specimen collection of the following bacteria.

- i) Staphylococcus
- ii) Streptococcus
- iii) Bacillus
- iv) Salmonella, Proteus, Escherichia, Pseudomonas, Klebsiella
- v) Bordetella and Neisseria
- vi) Spirochaetes: Treponema, Leptospira, Borrelia

- vii) Vibrio
- viii) Corynebacterium
- ix) Mycobacterium
- x) Clostridium.

8. INTRODUCTION TO MYCOSES

- a. Introduction, Morphology and Structure of fungi
- b. classification of pathogenic fungi.
- c. Nutrition and cultivation of fungi.
- d. Cutaneous, Sub cutaneous and Systemic Mycosis (in brief)
- e. Lab diagnosis of fungal Infections
- f. Opportunistic fungal infections

9. VIRAL INFECTIONS TO HUMAN:

- a. General properties of viruses,
- b. Classification of viruses
- c. Lab diagnosis of viral infections
- d. Cultivation of viruses
- e. Diseases caused, laboratory diagnosis and prevention of following viruses,
 - i) AIDS
 - ii) Hepatitis
 - iii) Polio
 - iv) Dengue
 - v) Postnatal/Congenital infections due to CMV
 - vi) Herpes Simplex Virus
 - vii) Rubella

10. BIOSAFETY:

- i) Principles of biosafety
- ii) Decontamination
- iii) Disposal of wastes

11. ADVANCED METHODS FOR MICROBIAL DETECTION

- i) Automation in Microbiology and antibiotic Sensitivity test
(Bactac, API 20E, Vitek)
- ii) Nucleic acid testing methods

12. QUALITY CONTROL IN MICROBIOLOGY

SECTION - II IMMUNOLOGY

1. INTRODUCTION TO IMMUNOLOGY

2. IMMUNITY

- i) Introduction
- ii) Classification of immunity
 - (1) Innate immunity
 - (2) Acquired immunity
 - (3) Active & Passive immunity
 - (4) Cell mediated immunity
 - (5) Humoral immunity

3. COMPONENTS OF IMMUNOSYSTEM

- i) Phagocytic cells
- ii) T cells
- iii) B cells

4. ANTIGEN

Introduction-

- i) Types – Immunogens & Haptens
- ii) Heterophile & Forssman antigen
- iii) Antigenic Determinants
- iv) Immunogenicity

5. ANTIBODY

- i) Structure & Diversity of antibody
- ii) Monoclonal Antibodies and their production
- iii) Polyclonal antibody

6. COMPLEMENT

- i) Introduction
- ii) Activation Various Pathway
- iii) Complement fixation test

7. HYPERSENSITIVITY

- i) Introduction and classification of Hypersensitivity
- ii) Immediate & delayed Hypersensitivity
- iii) Anaphylactic reaction
- iv) Tuberculin skin test

8. AUTOIMMUNITY

Basic concepts of Autoimmunity

9. VACCINES

- i) Introduction
- ii) Vaccination Schedule in India

10. ANTIGEN-ANTIBODY REACTION & THEIR APPLICATIONS:

- i) Precipitation tests: The ring test, Agar diffusion methods.
- ii) Agglutination tests: Tube test, agglutination microscopic and macroscopic test.
- iii) Other serological test: Fluorescent – antibody technique, Haemagglutination test. Lateral flow through assays and Immunochromatography test.
- iv) Introduction to Enzyme linked immunosorbent assay (ELISA), RIA, Dot immunoassay, Western Blot, PCR.

REFERENCE BOOKS:

**VEER NARMAD SOUTH GUJARAT UNIVERSITY,
SURAT**

**REVISED SYLLABUS FOR DIPLOMA OF MEDICAL TECHNOLOGY
(EFFECTIVE FROM JULY-2014)**

Paper II: CLINICAL PATHOLOGY AND PARASITOLOGY

SECTION – I CLINICAL PATHOLOGY

1. URINE ANALYSIS:

- i) Anatomy and Physiology of Urine formation.
- ii) Composition of Urine.
- iii) Collection, Preservation & Transportation of Urine.
- iv) Routine Examination Physical, Chemical & Microscopic.
- v) Correlation of urinary findings in various diseases.
- vi) Pregnancy Test

2. STOOL ANALYSIS:

- i) Collection, Preservation & Transportation of Stool.
- ii) Routine Examination Physical, Chemical & Microscopic.
- iii) Correlation and significance in various diseases.

3. CEREBROSPINAL FLUID:

- i) Formation of C.S.F.
- ii) Collection, Preservation & Transportation of C.S.F.
- iii) Composition of CSF.
- iv) Physical, Chemical & Microscopic Examination.
- v) Correlation of Abnormal C.S.F. findings in various diseases.

4. SPUTUM ANALYSIS:

- i) Anatomy and Physiology of Respiratory system.
- ii) Collection, Preservation & Transportation of sputum.
- iii) Physical, Microscopic & Bacteriological Examination.

5. EXAMINATION OF BODY FLUID:

- a. Transudate & Exudate
- b. Indications, Collection and Examination-Physical, Chemical & Microscopic of following body Fluids
 - i) Pleural,
 - ii) Peritoneal,
 - iii) Pericardial
 - iv) Synovial fluid.

6. HISTOPATHOLOGY TECHNIQUES:

- a. Routine & Special stains, Museum- Technique & Specimen preservation
- b. Tissue Processing and Staining
 - i) Microtomes-types, Tissues processing technique cryotome
 - ii) Fixative cleaning agents
 - iii) Automation in Histopathology- Tissue processors cryotome
 - iv) Sample preparation- glossing techniques
 - v) H & E stain, special stains & FNAC, Cytopathology Technique, staining methods.

7. SEMEN ANALYSIS:

- (1) Anatomy & Physiology of Male Reproductive System.
- (2) Formation of semen.
- (3) Collection
- (4) Physical, Chemical & Microscopic Examination as per WHO Recommendation.
- (5) Medico – legal significance of Semen examination.

8. GASTRIC ANALYSIS:

- (1) Anatomy and Physiology of Stomach.
- (2) Collection, Preservation, Transportation & analysis.
- (3) Significance and diagnostic importance of Gastric secretions in various clinical conditions.

SECTION – II PARASITOLOGY

1) INTRODUCTION OF CLINICAL PARASITOLOGY:

An elementary study of the types of animal associations, parasitism, commensalism and Symbiosis. Types of parasites, sources of infection, Classification of protozoa & Helminthes.

2) PROTOZOA:

Introduction, classification & study of individual Protozoa

- (i) Entamoeba histolytica
- (ii) Giardia lamblia
- (iii) Leishmania donovani
- (iv) Plasmodia its different species
- (v) Toxoplasma gondii.
- (vi) Trypanosoma.
- (vii) Trichomonas

3) CESTODES:

Introduction, classification & study of individual Cestodes.

- (i) Taenia saginata.
- (ii) Taenia solium.
- (iii) Echinococcus granulosus.

4) TREMATODES:

Introduction, classification & study of individual Trematodes

- (i) Schistosoma haematobium,
- (ii) Schistosoma mansoni
- (iii) Schistosoma japonicum.

5) NEMATODES:

Introduction, classification & study of individual Nematodes.

- (i) Intestinal Nematodes:
Ascaris lumbricoides, Ancylostoma deodenale, Necator americans, Strongiloides stercoralis,
Trichnella spiralis, Trichuris trichuria, Enterobius vermicularis.
- (ii) Somatic Nematodes:
Wuchereria bancrofti, Wuchereria malayi, Dracunculus medinensis.

REFERENCE BOOKS:

- 01 Text Book of Medical Laboratory Technology, P.B.Godkar, 1994, Bhalani Publishing House, Mumbai
- 02. Medical Laboratory Technology, Vol I & II, 1999, K.L.Mukharjee. Tata MacGraw Hill.
- 03. Medical Laboratory Technology, Ramnik Sood, 4th ed., 1994, Jaypee Brothers.
- 04. A Hand Book Of Clinical Pathology , Chakraborty & Battacharya, Academic Publisher.
- 05. Parasitology, K.D.Chatterjee, Chatterjee Medicaal Publisher.
- 06. Clinical Diagnosis and management by laboratory methods 20th Edition John Bernard Henry Saunders 2005.
- 07. Medical Parasitology 2nd edition, D.R.Arora, B.Arora, CBS Pub.& Distributer.
- 08. Text book Of Medical Parasitology, P. Chakraborty, New Central book Agency.
- 09. District laboratory practice in tropical countries VOL-2, Monica Cheesbrough, Cambridge University Press.
- 10. Concise Clinical pathology, Ila M. Vora, Pradeep Vaideeswar, Bhalani publishing House, Mumbai, India.

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Paper III: HAEMATOLOGY AND BLOOD BANKING

SECTION –I HAEMATOLOGY

- 1) **PHYSIOLOGY OF BLOOD**
 - (i) Normal Erythropoesis.
 - (ii) Leucopoesis.
 - (iii) Formation & Function of Blood Platelets.

2) A. INTRODUCTION

- (i) Collection of Blood samples for Haematological studies.
- (ii) Types of Anticoagulants.
- (iii) Capillary Blood, Venous blood & Storage of Samples.

B. HAEMATOLOGICAL TEST

- (i) Hemoglobin and its estimation.
- (ii) Red blood cell, White blood cell count, Platelet count-counting fluids preparation, Function.
- (iii) Study of Peripheral smear, Differential WBC count, Morphology of red Blood Cells,
- (iv) Romanowasky stains, Staining procedures, preparation of Stains, Artifacts & troubleshooting.
- (v) Haematocrit (PCV)
- (vi) Absolute Blood Indices.RDW, PDW, PCT.
- (vii)Erythrocyte sedimentation rate.
- (viii)Osmotic Fragility test-fluid preparation.

3) ANAEMIAS

- (i) Definition & Classification of Anaemias.
- (ii) Iron & B-12 deficiency anaemia.
- (iii) Anaemias of Chronic disorders & Aplastic anaemia.
- (iv) Haemolytic anaemia / Sideroblastic anaemia.
- (v) R.B.C. Metabolism & G-6PD deficiency anaemia.
- (vi) Polycythemia.

4) HAEMOGLOBINOPATHIES

- (i) Structure of Haemoglobin Molecule.
- (ii) Types of normal Haemoglobins.
- (iii) Abnormalities of Haemoglobin Molecule.
- (iv) Sickle Cell Anaemia.
- (v) Thalassemia
- (vi) Tests for Haemoglobinopathies: 1. Screening test (i) Sickling test
(ii) NESTROF
2. Confirmative test (i) Electrophoresis
(ii) HPLC

6) LEUKAEMIAS

- (i) Definition, Classification of Leukaemias.
- (ii) Cytochemical reaction.
- (iii) Acute & Chronic Myeloid Leukaemias.

7) BLOOD COAGULATION

- (i) Mechanism of Blood Coagulation.
- (ii) Bleeding time/ Clotting time/ Clot Retraction.
- (iii)Thrombin time/ Prothrombin time
- (iv)Coagulation disorders, Haemophilia A & Haemophilia B.
- (v) Platelet disorders.

8) Automation in hematology- Analyser- a) Principle, b) procedure, c) drawbacks & Advantages, d) trouble shooting.

9) Quality control and standard preparation in Hematology.

SECTION – II BLOOD BANKING

1) PRINCIPLES OF IMMUNOHAEMATOLOGY.

2) BLOOD GROUP SYSTEM –I

- (i) ABO blood Group system, subgroup of ABO, Variants of ABO blood group system.
- (ii) Rh blood group system.
- (iii) Serological techniques for detection of ABO & Rh antigens.
- (iv) Gel technique for blood grouping and serological Techniques.
- (v) AHG test.

3) BLOOD GROUP SYSTEM – II

- (i) Other Blood Group systems
- (ii) Importance of Atypical antibodies, their detection and clinical significance

4) BLOOD COLLECTION

- (i) Screening of Donor,
- (ii) Blood Collection,
- (iii) Storage and transportation of blood,
- (iv) Component preparation:
 - a) Red cell concentrate
 - b) Washed red cells
 - c) FFP
 - d) Cryoprecipitate
 - e) Platelet concentrate

5) COMPATIBILITY TESTING

- (i) Compatibility testing and special methods of routine and emergency crossmatch
- (ii) Trouble shooting in grouping and crossmatching

6) TRANSFUSION REACTION

- (i) Types of Transfusion reaction,
- (ii) Investigation of Transfusion reaction.

7) HAEMOLYTIC DISEASE OF NEWBORN

Haemolytic disease of the New born due to

- (i) ABO incompatibility,
- (ii) Rh incompatibility
- (iii) Other blood group incompatibility.

8) AUTOMATION & BIOSAFETY IN BLOOD BANKING.

9) QUALITY CONTROL IN BLOOD BANKING.

REFERENCE BOOKS :

1. Clinical Haematology. M.M.Wintrobe. Kothari's Indian Edition.
2. Practical Haematology. J.A.Dacei & S.M.Lewis The English Language Book Society. 8th ed., ELBS
3. Handbkook of Medical Laboratory Technology. Bharucha, Meyerm, Moody, Carman, Vellore.
4. Technical Manual, Americal Association of Blood Banks.1996.
5. Compendium Transfusion Medicine, Dr. R.N. Makroo, J. Mitra.

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Paper IV: CLINICAL BIOCHEMISTRY

SECTION – I INTRODUCTION

1) GENERAL LABORATORY TECHNIQUES:

- i) Important properties of water
- ii) Balances and weighing
- iii) Units of measurement
- iv) Preparation of solution
- v) H⁺ concentration and pH
- vi) Acid and Base,
- vii) Buffers and buffer action
- viii) Indicators
- ix) Osmosis and osmotic pressure
- x) Safety in the Clinical Laboratory

2) ANALYTICAL PROCEDURES :

- i) Photometry: Introduction, Principle of absorption of radiation. The Beer-Lambert's law and its applications in clinical chemistry.
- ii) Electrophoresis: Introduction, Principle, basic components, types.

3) INSTRUMENTATION:

- i) Principle,
- ii) Basic components and use in biochemistry of the following:
 - (1) PH meter
 - (2) Colorimeter
 - (3) Spectrophotometer
 - (4) Flame photometer
 - (5) Centrifuges

- 4) **AUTOMATION:**
 - i) Principles
 - ii) Types and Applications

- 5) **QUALITY CONTROL IN BIOCHEMISTRY:**
 - i) Introduction,
 - ii) Importance of Quality Control.
 - iii) Accuracy,
 - iv) Precision and Reliability;
 - v) Distribution of data, Central tendency
 - vi) Standard Deviation.
 - vii)Preparation of Q.C. Chart,
 - viii)Normal range,
 - ix) Coefficient of variation of standards & controls.
 - x) Quality Control procedures

- 6) **CLINICAL INFORMATICS, LABORATORY INFORMATION PROCESSING, WEB REPORTING.**

SECTION – II BIOCHEMISTRY

BIOCHEMISTRY AND ROUTINE BIOCHEMICAL TESTS:

- 1) **CARBOHYDRATES:-**
 - i) Introduction
 - ii) Classification of carbohydrates
 - iii) Regulation of Blood Glucose
 - iv) Determination & Clinical Significance of blood glucose and urine glucose
 - v) Hyperglycemia and Hypoglycemia
 - vi) GTT
 - vii)Diabetes

- 2) **PLASMA PROTEIN: -**
 - i) Introduction
 - ii) Function of plasma proteins
 - iii) Determination of proteins
 - iv) Clinical significance of plasma proteins

- 3) **LIPIDS AND LIPOPROTEINS :-**
 - i)Introduction of lipids and lipoproteins
 - ii)Essential fatty acids
 - iii)Determination of Cholesterol
 - iv)Triglycerides and lipoproteins
 - v)Clinical significance of lipids and lipoproteins

- 4) **ENZYMES:**
 - a. Introduction to enzymes, as catalysts, nomenclature, classification,properties, factors affecting enzyme activity,isoenzymes and coenzymes.

b. Clinical Enzymology

- i) Therapeutic, diagnostic and analytical uses of enzymes
- ii) Enzyme assays in clinical Biochemistry
- iii) Conventional methods and Kinetic methods of determination and their clinical significance for,
 1. Phosphatases
 2. Transaminases
 3. Lactate dehydrogenases
 4. Creatine Kinase
 5. Amylase
 6. Gama glutamyl Transferase

5) HORMONES:

- i) Introduction to Thyroid and parathyroid hormones,
- ii) Adrenal Hormone,
- iii) Pituitary hormones and sex hormones.
- iv) Determination of T₃, T₄, TSH, β-HCG.

6) VITAMINS:

- i) Introduction
- ii) Determination of Vit. B₁₂ & Vit. D₃

7) ELECTROLYTES AND BLOOD GASES:

- i) Introduction of electrolytes,
- ii) Determination of sodium, potassium, serum calcium, urinary calcium, phosphorus, Chloride, iron and their clinical significance.

8) FUNCTION TESTS:

- i) Liver function test
- ii) Renal function tests
- iii) Pancreatic function tests
- iv) Cardiac function tests.

9) MEDICO LEGAL ASPECTS IN LABORATORY FUNCTIONS.

REFERENCE BOOKS:

1. Outlines of Biochemistry. E.Conn, K.Stumpf, G.Bruening & H.Dol, 5/E, John Welley & Sons.
2. Practical Clinical Biochemistry. Horald Varley, 4/E, CBS Publishers.
3. Clinical Chemistry – Interpretation & Techniques, 2nd ed., Kaplan & Lavarnel szabo, Lea & Febiger Publication.
4. Medical Laboratory Technology, 5th reprint 1999, Vol. I, II & III, K.L.Mukharjee, Tata McGraw Hill.

5. Medical Laboratory Technology – Methods & Interpretation, Sood, 4th ed., Jaypee Brothers.
6. Textbook of Medical Laboratory Technology, P.B.Godkar, 1994, Bhalani Publishing House, Mumbai.
7. Hand Book of Medical Laboratory Technology. Chitra Bharucha, H.Meyer R.H.Carman, C.M.College & Hospital, Vellore.
8. Fundamental of Biochemistry A.C.Deb, New Central Book Agency.
9. Clinical Biochemistry. 3rd ed., L.A.Kaplan & A.J.Pesce, The C.V.Mosbey Co.
10. Fundamental of Clinical chemistry.4th ed., Edited by N.W.Tietz, W.B.Saunders Company.
11. Clinical guide to laboratory Tests. 3rd ed., 1995, Tietz.
12. Tietz Text Book of Clinical Chemistry, 2nd ., 1994, Burtis, W.B.saunders Company.
13. Basic Techniques in Clinical Laboratory Science.3rd ed., 1992, Linne, Mosbey Publication.
14. Lynch's Medical Laboratory Technology, 4th ed., Raphael, Asian Edition, Saunders Company Publication.
15. Textbook of biochemistry for medical students, 4th edition, D.M.Vasudevan, Shreekumari S. Jaypee brothers medical pub.ltd, Newdelhi.
16. Biochemistry, 3rd edition, U. Satyanarayan, U. Chakrapani, Books & Allied Pvt Ltd Kolkatta.
17. Textbook of medical biochemistry, 5th edition, M.N.Chatterjee, Rana Shinde, Jaypee brothers Medicalpub Ltd, New delhi.

**VEER NARMAD SOUTH GUJARAT UNIVERSITY,
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PROPOSED MODIFIED REVISED PRACTICAL SYLLABUS OF
DIPLOMA IN MEDICAL TECHNOLOGY
(Effective from July-2014)**

PRACTICALS BASED ON PAPER – 1

SECTION – I MICROBIOLOGY

1. Study of Compound Microscope.
2. Cleaning, Neutralization and preparation of glassware for sterilization.
3. Examination of living Bacteria.
 - a) Wet mount preparation

- b) Hanging – drop technique.
 - c) Semisolid stab agar test.
3. (A) Staining of the bacterial cell:
 - a) The Simple Stain
 - b) The Negative Stain.
 (B) Differential Staining
 - a) The Gram Stain
 - b) The Acid fast Staining.
 (C) Special Staining
 - a) The Spirocheate Stain
 - b) The Metachromatic Granules Stain.
 - c) The spore Stain
 - d) The Capsule Stain
 - e) The Flagella Stain
4. Study of some important biochemical reactions.
 - a) Indole Test.
 - b) Methyl red Test.
 - c) V.P. Test.
 - d) Citrate Utilization Test.
 - e) H₂S Production (2% peptone)
 - f) Study of TSI slants with different
 - g) Fermentation of Sugars
 - h) Test for enzyme activity-Oxidase, Catalase, Coagulase, Urease,
5. Preparation of media, pH adjustment and preparation of buffers
 - (A) Bacteriological Media
 - a) Nutrient agar
 - b) MacConkey' agar
 - c) EMB agar
 - d) Wilson & Blair's agar for Salmonella sp.
 - e) CLED medium for Urinary Tract Infection.
 - f) King's medium for Pseudomonas sp.
 - g) Manitol Salt agar for Staphylococcus sp.
- (B) Mycological Media
 - a) Potato – dextrose agar.
 - b) Glucose Yeast Extract agar.
 - c) Sabouraud' agar
6. PURE CULTURE STUDY OF THE FOLLOWING CULTURES.
 - (i) *Bacillus cereus*
 - (ii) *Staphylococcus aureus*
 - (iii) *Escherichia coli*
 - (iv) *Enterobacter aerogenes*(*Klebsiella mobillis*)
 - (v) *Klebseilla pneumoniae*
 - (vi) *Proteus vulgaris*
 - (viii) *Salmonella typhi* / *paratyphi A* / *paratyphi B*
 - (ix) *Pseudomonas aerugenosa*
7. Demonstration of common fungi - Penicillin, Aspergillus, Rhizopus, Mucar, Yeast.
8. Isolation and identification of aerobic and anaerobic bacterial / pathogens from pathological specimens.

SECTION – II IMMUNOLOGY

Diagnostic tests:

1. ICT/Dot immunoassay/ Flow through assay for HIV Ab
2. ICT/Dot immunoassay/ Flow through assay for HBs Ag
3. ICT/Dot immunoassay/ Flow through assay for HCV Ab
4. Slide / Tube/ Strip / Cassette, Dot immunoassay test for typhoid
5. Slide test for syphilis/Flow through /Spot/ Immunodot for Syphilis
7. Slide / Strip / Cassette test for Pregnancy
8. Latex test for Rheumatoid arthritis
9. Latex test for C-Reactive protein
10. Latex test for Anti Streptolysin O(ASO).
11. Immunoassays for Tuberculosis
12. Leptospirosis ICT (Demonstration)
13. Chickungunya ICT (IgG,IgM) (Demonstration)
14. Mantoux test. (Demonstration)

REFERANCE BOOKS :

1. Medical Laboratory Technology. 5th Reprint 1999, Vol. I,II & III, K.L.Mukharjee Tata McGraw Hill.
2. Text Book of Medical Laboratory Technology, P.B.Godkar, 1994, Bhalani Publishing House.
3. Medical Laboratory Technology, Ramnik Sood 4th ed., 1994, Jaippee brothers.
4. Hand book of Medical Laboratory Technology.Bharucha, Meverm, Mody Carman.
5. Lynch's medical Laboratory Technology,3rd ed., Stanley S. Raphael, W.B.saynders Company, Asian Edition.
6. Practical Medical Microbiology. Collee, Duguid, fraser, Marmlom,24thed.,Churchill Livingstone.
7. Laboratory Exercises in Microbiology, 2nd ed., Michael J. Pelczer,Macgraw Hill Book Company.
8. A Hand book of Practical Immunology. G.P.Talwar, Vikas Publishing House Pvt. Ltd.
9. Collection and Handling of Laboratory Specimen – A Practical guide,1983,Editor T.M.Slockbower and T.A. Bhumenfeld,L.B.Lippincott Company,USA.
10. Crown & Steel's Mannual for the Identification of medical Bacteria.3rd Ed, Edited by G.I. Barrow and R.K.A. Felthan, Pub. Cambridge University Press.

PRACTICALS BASED ON PAPER – II

SECTION – 1 CLINICAL PATHOLOGY

1. Urine Analysis: Physical, Chemical, Microscopic examination.
2. Stool Analysis: Physical, Chemical, Microscopic examination.
3. Cerebrospinal Fluid: Physical, Chemical, Microscopic examination.
4. Sputum examination: Physical, Microscopic
5. Gastric Analysis: Chemical examination of gastric juice.
6. Semen examination: Physical, Chemical, Microscopic examination.
7. Body fluids (each separately): Physical, Chemical, Microscopic examination.
8. Cutting, Fixation and processing of tissues (Demonstration).
Staining – (i) Haematoxylin and Eosin for paraffin sections.
 (ii) PAP Stain for cytology.

SECTION – II PARASITOLOGY

1. Test for malarial parasite: 1.Thin smear, Thick smear
2. ICT
2. Test for Filarial parasite: (slide)
3. Dehaemoglobinization techniques for Malaria & Filaria.

REFERENCE BOOK:

1. Medical Laboratory Technology, 5th reprint 1999, Vol. I, II & III, K.L.Mukharjee.Tata McGraw Hill.
2. Text Book of Medical Laboratory Technology P.B.Godkar, 1994,Bhalani Publishing House,Mumbai.
3. Medical Laboratory Technology, Ramnik Sood,4th ed., 1994,Jaypee Brothers.
4. Hand Book of Medical Laboratory Technology, Bharucha, Meyerm, Mody, Carman.
5. Lynch's Medical Laboratory Technology, 3rd ed., Stanley S.Raphael,W.B.Saunders Company, Asian edition.
6. A Hand Book of Clinical Pathology,Chakraborty & Bhattacharya, Academic Publishers.
7. Parasitology, K.D.Chatterjee,Cheterjee Medical publishers.
8. Collection and Handling of Laboratory Specimens – A Practical Guide, 1988 Editor T.M.Slockbower & T.A.Bhumenfeld, J.B.Lippincott Company,USA.
9. Basic laboratory Method in Medical Parasitology, WHO, 1991.

PRACTICAL BASED ON PAPER III

SECTION – 1 HAEMATOLOGY

1. Methods of Blood Collection and Anticoagulants
2. Haemoglobin estimation: Sahli's method and Cyanmethaemoglobin method.
3. Total R.B.C.
4. Total W.B.C. Count.
5. Differential Count.
6. Platelet Count.
7. Reticulocyte Count
8. E.S.R.
9. Packed cell volume/ Determination of Haematocrit.
10. Bleeding time, Whole Blood Coagulation time and Prothrombin time.
11. Osmotic fragility test (Demonstration).
12. Preparation of various stains & reagents for hematology test
13. Sickling test.

14. Immature cells of leukemia (Demonstration).
15. Interpretation of Automated strips in various clinical condition.

SECTION – II BLOOD BANKING.

1. ABO cell grouping and serum grouping by slide and tube method.
2. Rh typing – Various Techniques.
3. Anti A/ Anti B titer
4. Anti D titration by albumin and indirect antiglobulin technique
5. Test for HBsAg (Hepatitis B surface Antigen) ELISA and Rapid Test (Demonstration).
6. Test for HIV Antibodies (ELISA and Rapid Test) (Demonstration).
7. (a) Cross matching procedures.
(b) Direct Antiglobulin (Coomb's) Test.
(c) Indirect antiglobulin test.

REFERENCE BOOKS:

1. Medical Laboratory Technology, 5th reprint 1999, Vol. I, II & III, K.L. Mukharjee, Tata McGraw Hill
2. Text book of Medical Laboratory Technology, P.B. Godkar, 1994, Bhalani Publishing House, Mumbai.
3. Medical Laboratory Technology, Ramnik Sood, 4th ed., 1994, Jaypee Brothers.
4. Hand book of Medical Laboratory Technology, Bharucha, Meyerm, Mody, Carman.
5. Lynch's Medical Laboratory Technology, 3rd ed., Stanley S. Raphael, W. B. Saunders Company, Asian edition.
6. Practical Haematology. J. A. Dacie & S. M. Lewis, The English Language Book Society, 8th ed., EIBS
7. Collection and Handling of Laboratory Specimen – A Practical Guide, 1983, Editor T. M. Slockbower & T.A. Bhumenfeld, J. B. Lippincott company, USA

PRACTICAL BASED ON PAPER IV

SECTION – I INSTRUMENTATION

1. Operation of pH meter, Single pan Balance, Spectrophotometer, Colorimeter, Autoanalyzer, Electrophoresis. (Demonstration)

SECTION – II CLINICAL BIOCHEMISTRY

Preferably all the test should be done on semi Auto analyser.

- 1) Blood Glucose/Sugar estimation and GTT.
- 2) Blood Cholesterol – Free & Total HDL Cholesterol, LDL Cholesterol.
- 3) Serum Triglyceride
- 4) Serum Total Protein and Serum Albumin and A/G ratio
- 5) Microalbumin test
- 6) Blood/Urine Urea.

- 7) Blood /Urine Creatinine.
- 8) Blood /urine Uric Acid
- 9) Serum Calcium / Ionized Calcium
- 10) Serum potassium
- 11) Serum Sodium
- 12) Serum Chloride
- 13) Serum Iron, and TIBC (Total Iron Binding Capacity)
- 14) Serum Bilirubin.
- 15) Serum Alkaline Phosphatase.
- 16) Serum Acid Phosphatase.
- 17) S.G.O.T
- 18) S.G.P.T.
- 19) Serum Amylase.
- 20) Serum Lipase
- 21) Serum Protein Electrophoresis and Lipoprotein electrophoresis (Demonstration).
- 22) Cardiac Troponin T (Demonstration)
- 23) Cardiac Troponin I (Demonstration)
- 24) T3 ,T4, TSH ELISA (Demonstration)

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