

## Training Schedule

### Vocational Stream

#### DMLT (Biochemistry 477)

S. No.	Schedule		Theory		Practical		Instructions to the trainer	Learning outcomes
	Week	Day	Topic	HRS	Topic	HRS		
	Week 1	Day 1	Glassware in lab, weighing of analytes.  Concept of Normality, Molarity, Molality	2	Types of pipettes and their use; Balances, types and use.  Preparation of molar solution.  Preparation of Normal Solution	3	Explain the difference between the Normal, Molar and Molal solutions  Check the availability of stock solution.	Familiarity with basic terminology of Normality, Molarity, Molality  Does calculation of Normal, Molar and Molal Solution  Calibrates the Pipettes  Prepares the Normal, Molar & Molal Solution
		Day 2	Concept of percent solution (weight/ weight, weight/ volume, volume/ volume)	2	Preparation of saturated solution, preparation of percent solution; volume/ volume solutions; weight/ volume solutions	3	Explain the concept of different types of solutions.  Check availability of analyte and working balance.	Familiarity with different types of percent solutions  Calculates and prepares the different types of percent solutions (percent solution-weight/ volume solutions)
	Week 2	Day 1	Acid- base Balance, water and Electrolytes  Body water, osmolarity, extra	2	Preparation of buffer solution  Preparation of buffer : acidic basic and neutral	3	Explain the concept of buffers in the body  Explain the acid-base	Describes the importance of acid-base homeostasis in body and the importance of body buffers for same

			and intra cellular sodium & potassium; buffers				homeostasis in the body. Check availability of stocks for preparation of buffers	Calculates and Prepares the working buffers from available stock solutions and stock solutions as well
		Day 2	Explain pH Explain Buffer System in blood, role of lungs and kidneys in acid- base balance	2	Indicatorsof pH, Determination of pH of unknown solution; pH meter- components & maintenance	3	Explain the chemical and physiological buffers in blood Ensure availability of pH indicator, buffer solutions and working pH meter	Describes the role of chemical and physiological buffer systems in maintaining acid-base homeostasis Determines the pH of unknown solution Describes the working and maintenance of a pH meter
	Week 3	Day 1	Analytical techniques and instrumentation Colorimetric techniques	2	Colorimeter: Principles, uses components and maintenance.	3	Explain the various techniques and related instruments available in the lab for analyte estimation Explain the principles of colorimetry (Lambert Beer Law) Ensure availability of working colorimetry	List some common analytical techniques used in the lab Explains the principle of colorimetry Performs colorimetry based analysis of analytes in the laboratory
		Day 2	Light transmission and scattering techniques	2	Spectrophotometer: components and uses	3	Introduce the principles for the techniques of nephelometry and	Describes the principles of nephelometry and turbidimetry

						turbidimetry  Ensure availability of working spectrophotometer and appropriate analyte for estimation using the instrument	Describes the principles of spectrophotometry and correlate it with the previously discussed colorimetry  Performs the estimation of analytes using the spectrophotometer
	Week4	Day 1	Carbohydrates: - Definition, chemistry, classification of carbohydrates - Sources and composition - Digestion and absorption of carbohydrates - Metabolism: Glycolysis-aerobic, anaerobic, energetic citric acid cycle and its energetic.	2	Determination of blood glucose	3  Discuss the chemistry, classification and digestion/absorption of carbohydrates  Discuss the metabolic pathways of carbohydrate metabolism, with special focus on glycolysis and Citric Acid cycle  Ensure availability of analytes/chemicals for estimation of blood glucose, and working colorimeter/semi-auto analyser	Lists the classification of carbohydrates  Explains the steps in carbohydrate metabolism  Lists the energetics of aerobic & anaerobic glycolysis and Citric Acid cycle  Performs the estimation of blood glucose levels in the laboratory using available analytes and correlate with clinical condition of the patient
		Day 2	Glycogenesis, glycogenolysis (outline), role of liver and muscle glycogen  Gluconeogenesis: hormonal regulation of blood sugar level. Lactose intolerance diabetes	2	Poster preparation of clinical criteria for diagnosis of a patient of diabetes mellitus, along with the testing procedure	3  Outline the process of glycogen metabolism, both synthesis and degradation  High the different roles of liver and glycogen metabolism	Explains the role of liver and muscle glycogen  Lists the actions of various hormones on blood glucose level and glycogen metabolism

			mellitus				Discuss the regulatory action of insulin, glucagon and epinephrine on blood glucose levels	Describes the diagnostic criteria with help of a poster presentation
	Week 5	Day 1	Protein: Definition of proteins Amino acids Functions of proteins Digestion and classification of amino acids and proteins  Structural organization of protein in brief	2	Non-protein nitrogenous compound  Determination of serum urea, uric acid and creatinine, urea clearance and creatinine clearance	3	Discuss amino acids, classification and metabolic roles  Discuss proteins, digestion and functions  Discuss the structural organization of the proteins  Arrange for lab reagents for performance of estimation serum urea, uric acid and creatinine	Describes the amino acids and their classification  Lists the important biological functions of amino acids  Lists the steps in the digestion and absorption of proteins from diet  Performs various biochemical analysis for estimation of serum urea, uric acid and creatinine
		Day 2	Specialized products of amino acids phenylalanine and tyrosine transmutation (importance of transaminases) Domination and urea cycle	2	Demonstration of serum proteins A-G ratio and zinc sulphate turbidity test	3	Discuss the urea cycle  Discuss the special products of amino acids and their synthesis in the body  Arrange for demonstration of serum proteins A-G ratio via zinc sulphate turbidity test	Lists the reactions of urea cycle  Lists some important special products synthesized from amino acids in the body  Identifies the precipitation of proteins from solution
		Day 1	Lipids: Chemistry, definition, classification of lipids, classification of fatty acids,	2	Demonstration of structure & functions of Serum lipids through video	3	Discuss the chemistry and classification of lipids  Describe the process of lipid	Lists the steps in the digestion and transport of lipids in the body

	Week 6		examples and function of common lipids, essential fatty acids and their importance. Digestion and absorption / ketone body- types and importance		Determination of serum cholesterol, triglycerides		digestion and transport in the human body  Describe the biosynthesis and metabolic role of ketone bodies in the body  Arrange for the availability of lab reagents for analysis of serum cholesterol and triglycerides	Performs the estimation of serum cholesterol and triglycerides
		Day 2	Cholesterol sits importance  Classification and functions of lipoprotein  Atherosclerosis	2	Collection and preservation of blood, serum and plasma.  Determination of HDL Cholesterol, <i>Friedewald</i> formula for calculation of VLDL- Cholesterol and LDL- Cholesterol.	3	Describe the cholesterol metabolism in the body and its importance  Discuss the function and classification of lipoproteins  Discuss the phenomenon of atherosclerosis and its clinical implication	Lists the important biological roles of cholesterol in the body  Calculates LDL values as per <i>Friedewald</i> formula  Identifies appropriate sample tube for collection of blood sample as per the test required  Performs the estimation of HDL cholesterol
	Week 7	Day 1	Enzymes: definition coenzymes,  Factor effects enzymes activity, isoenzymes and clinical significance of enzymes	2	Demonstration through videos/ charts/ models etc. factors affecting enzyme activity	3	Describe the enzymes and coenzymes  Discuss the factors affecting enzyme activity  Describe isoenzymes and their role in diagnosis and treatment	Describes the biological function of enzymes, and role of coenzymes  Lists the conditions where isoenzymes can be used for diagnosis and treatment  Identifies the effect of pH and temperature on enzyme action

							by testing their effects on activity of alkaline phosphatase	
		Day 2	Principles of clinical enzymology Causes of diseases	2	Display of charts/ ppts of the Clinical enzymology	3	Describe the principles used in the estimation of enzyme concentrations in blood and other body fluids  Highlight the common enzymes which are assessed in various clinical conditions	Lists the common enzymes which are assessed in various clinical conditions  Assess the quantity of some common enzymes (ALT, AST, etc.) in a sample by Biochemical testing
	Week 8	Day 1	Nucleotide chemistry, metabolism (purine catabolism) gout, structure, functions of DNA, RNA	2	Demonstration of UV characterization of DNA	3	Discuss the metabolism of purines and pyrimidines  Discuss the functions of DNA & RNA  Discuss the biochemical basis of gout and its common causes.	Lists the biological functions of nucleotides  Identifies the important functions of DNA & RNA  Quantifies the amount of DNA in a given sample with the help of spectrophotometer
		Day 2	Relevance of blood level of glucose, urea, lipid profile	2	Cleaning of glass ware  Preparation of chromic acid solution	3	Discuss the relevance of blood level of glucose, urea, lipid profile	Lists the relevance of blood level of glucose, urea and lipid profile  Handles the glassware and carry out cleaning  Prepares the chromic acid solution in Laboratory
		Day	Explain the urine levels of sugar, creatinine, proteins	2	Diagnostic tests for urine - Collection and preservation - Physical characteristics	3	Discuss the composition of normal urine.  Discuss the concept of	Lists the parameters to be assessed during the analysis of the urine

	Week 9	1			(colour, volume, order appearance) and specific gravity - Normal constituents: qualitative test for urea, uric acid, creatinine, calcium, phosphorous and chloride		abnormal constituents of urine  Arrange for various lab equipment for analysis of normal urine.	Lists some common abnormal constituents of urine  Performs the analysis of urine and assess the normal constituents of urine
		Day 2	Conditions with abnormal constituents in urine	2	Abnormal constituents of urine: Qualitative test for: sugar albumin, ketone bodies, blood, bile salts and bile pigments, determination of sugar and albumin in with (quantitative) use of dipstix, additional qualitative test for urine, pentosuria, phenylketonuria	3	Discuss the clinical conditions in which the various abnormal constituents of urine may be found  Discuss the various tests which can be performed for testing the presence of abnormal constituents of urine  Arrange for the chemicals/analytes for these tests	Analyses the abnormal constituents and the clinical conditions in which they may be found in the urine  Performs the analysis of urine for the presence of abnormal constituents in the laboratory
	Week 10	Day 1	Explain the Kidney function tests	2	Determination of serum urea, creatinine	3	Describe the various tests which can be used to assess the function of the kidney	Summarizes the various test used to assess the function of the kidney  Demonstrates the estimation of serum urea and creatinine
		Day 2	Explain the Liver function tests	2	Determination of transaminases (ALT & AST)	3	Explain the functional capacity of Liver	Assess the functional capacity of the Liver

			Various tests undertaken to measure liver function and damage		Determination of phosphatases (alkaline phosphatase and acid phosphatase)  Determination of any case serum bilirubin: total and direct bilirubin			Demonstrates the common tests that form part of the liver function tests profile  Identifies the method used to measure albumin and total protein in Serum  Calculates A:G ratio
	Week 11	Day 1	Electrochemistry: Oxidation & reduction Electrochemical cells	2	Demonstration of Electrochemical cells and its components	3	Discuss the examples of Oxidation & Reduction	Represents the Electrochemical cell  Defines the Oxidation & reduction
		Day 2	Ion selective Electrodes, direct and Indirect	2	Chart preparation & Group discussion on Ion selective Electrodes  Display the Electrodes components & its Maintenance	3	Group discussion on advantages & limitations on I.S.E	List out the necessary precautions and limitation for Ion Selective electrode  Summarises the components of Electrodes  Explains the principle & Instrumentation of pH Electrode
		Day 1	Electrolytes :Electrolyte solution  Explain the Biosensors  Electrochemical Detectors	2	Determination of Na <sup>+</sup> , K <sup>+</sup> and Cl. Determination of inorganic phosphorous  Determination of Ca  Representation of reactions on	3	Explain about the instrumentation and discuss about advantages & uses of Biosensors	Explains the Biosensors  Identifies the intimacy between the biocatalyst & the transducer  Determines the serum electrolytes such as Inorganic



	Week 12		Electrochemical potential Serum Electrolytes		standard electrode potentials and standard hydrogen electrode			phosphorous and Calcium
		Day 2	Blood Gases Biological oxidation, Electron Transport Chain and oxidative phosphorylation	2	ABG analysis for acid-base (Arterial Blood Gas) in balance  Display chart on oxidative phosphorylation	3	Revise the electrolytes of previous class and its importance of Blood gas testing  Discuss the importance of Biological oxidation, Electron Transport Chain and oxidative phosphorylation	Analyses the blood gas testing  Identifies the importance of Blood gas testing  Explains the biological Oxidation - Reduction
	Week 13	Day 1	Vitamins: definition, classification according to solubility, individual vitamins, sources, functions, RDA, deficiency and toxicity	2	Demonstration of Fluorometer  Discuss the difference in Water soluble & Fat soluble vitamins	3	Explain the classification Of Vitamins	Classifies the vitamins  Describes the Water soluble & Fat soluble vitamins  Analyses the symptoms of Vitamin deficiency diseases
		Day 2	Minerals: Individual Minerals: calcium, phosphate, iron, zinc, copper, their source, RDA, absorption, transport, excretion of iron, functions, disorders related to above said minerals	2	Distillation of water, setting up glass distillation unit and metal water distillation.  Distillation of water: single, double distilled water.	3	Check the availability of the materials for the same  Guide learners how to perform	Enumerates types of Minerals  Demonstrates the chart related to daily requirements of minerals

	Week 14	Day 1	Hormones: Functional importance of insulin, glucagon, Thyroid hormones, parathyroid hormones, growth hormones	2	ELISA, estimation of different hormones (insulin, T <sub>3</sub> , T <sub>4</sub> , TSH, free T <sub>3</sub> , T <sub>4</sub> ) level in human blood by RIA/ELISA	3	Elucidate the functional importance of Hormones Discuss the clinical significance	Defines the characteristics of Hormones Describes the functional importance of Hormones Demonstrates the ELISA and estimation of Hormones
		Day 2	Nutrition: Basal metabolic rate- definition, normal values, Factors affecting BMR Energy requirements (with age / sex), thermogenesis Nutritional aspects of proteins, essential amino acids, composition of food, balanced diet, protein energy Malnutrition: Kwashiorkor, Marasmus	2	Display the Food pyramid Chart representation of Energy requirement of infants and children	3	Display through pictures/videos the protein energy Malnutrition	Identifies the basal metabolic rate Classifies the energy requirements in daily life
	Week 15	Day 1	Electrophoresis, principles of electrophoresis, different types, application	2	Demonstrate the Electrophoresis techniques immune - diffusion and iso-electric focussing, HPLC. Separation of serum proteins	3	Explain the abbreviations Discuss the applications	Demonstrates the Electrophoresis and its components Enlists the different variants of electrophoresis

					by Agarose gel electrophoresis			Performs the Agarose gel Electrophoresis for separation of serum proteins under supervision in the laboratory
		Day 2	Chromatography Mass spectrophotometer for separation of amino acids, Proteins and other analytes	2	Demonstrates the Chromatography <ul style="list-style-type: none"><li>- Paper chromatography</li><li>- Thin layer chromatography</li></ul>	3	Discuss the principle of chromatography Discuss the different types of chromatography Arrange lab reagents for performance of any one type of chromatography	Enlist the different types of chromatography Performs the paper/thin layer chromatography under guidance in the laboratory
	Week 16	Day 1	Principal of immuno chemical techniques like immuno electrophoresis and immuno blotting.	2	Demonstrate Immuno assay techniques: <ul style="list-style-type: none"><li>- Immuno electrophoresis</li><li>- Immune blotting</li></ul>	3	Discuss the principle of immuno electrophoresis Discuss the technique of immunoblotting Arrange for reagents for performance of immunoassays.	Familiarity with the principle of immunoelectrophoresis and immunoblotting Performs Immunoassays under supervision
		Day 2	Radioactive isotopes, their application in biomedical search and chemical diagnosis and measurements of radioactivity, tracer techniques.	2	Demonstration (live or via recorded video) of operation and maintenance of centrifuge	3	Describe the concept of radioactivity Discuss the radioactive isotopes used in biomedical research and diagnosis Describe the tracer techniques for radioactivity	State the common biomedical techniques which make use of radioisotopes Identify the parts of a centrifuge
		Day	Basic principles of radioactive	2	Demonstrate the Radio	3	Discuss the principles of radioactivity measurements	Explains the principle of radioactivity

	Week 17	1	measurements.		Immuno Assay (RIA)  - For hormones  - For tumor markers		Discuss the precautions to be used while during radio immunoassay Visit to Radio Immunoassay lab	Summarizes the precautions to be used while performing the radio-immunoassay
		Day 2	Radioactive isotopes, their application in biomedical search and chemical diagnosis  Measurements of radio activity  Tracer techniques	2	Demonstration of radioactive handling substance  Precautions and safety gear during use of precautions	3	Discuss the health effects of tracer techniques	Defines the Radioactive isotope  Describes the excitation of Solids and Liquid  Explains the Tracer Technique
	Week 18	Day 1	Explain tumor markers for different cancers : CEA  CA-125,  APF  Prostate specific Antigen	2	Estimation of cancer markers PSA by ELISA  Demonstration of one and more tests on newer modalities live Chemiluminescence, turbidity etc	3	Discuss the role of tumor markers in the diagnosis of various malignancies as well as non-malignant tumors  Discuss the advantages of the newer modalities for the analysis for tumor markers  Arrange for a visit to a laboratory with newer testing modalities  Arrange for ELISA kit for PSA (or any other) test	Enlists the various tumor markers and the corresponding clinical conditions for which they can be used  Performs ELISA test under supervision  Enlists the newer testing modalities for tumor marker testing
		Day 2	Immuno chemical techniques  Methods of analysis  Immunoprecipitation,	2	Demonstrate Agglutination technique through video	3	Discuss through pictures and chart with examples	Describes principles of these techniques  Summarises the methods of

			Immunoturbidimetry & Immunofixation				Agglutination	
	Week 19	Day 1	<p>Importance of different body fluid analysis:</p> <ul style="list-style-type: none"> <li>- Gastric Juice Analysis`</li> </ul>	2	<p>Demonstrate the Gastric Juice Analysis:</p> <ul style="list-style-type: none"> <li>- Determination of free and total acidity</li> <li>- Gastric function test</li> </ul>	3	<p>Discuss the different body fluids in the different compartments of the body. Briefly discuss their diagnostic relevance</p> <p>Ensure availability of titration apparatus and reagents</p>	<p>State the different types of the body fluids</p> <p>Lists clinical conditions in which specific body fluid analysis will be of significant</p> <p>Demonstrates the biochemical analysis of gastric fluid.</p>
		Day 2	<p>Importance of analysis of cerebrospinal fluid, pleural fluid and ascitic fluid</p>	2	<p>Analysis of cerebrospinal fluid</p> <ul style="list-style-type: none"> <li>- Determination of sugar</li> <li>- Determination of proteins</li> <li>- Determination of chloride</li> </ul> <p>Pleural/ ascitic fluid analysis</p> <ul style="list-style-type: none"> <li>- Sugar, protein amylase , transudate exudates</li> </ul>	3	<p>Discuss the importance of CSF, Pleural fluid and ascitic fluid in different disease conditions</p> <p>Arrange for different body fluids for testing purpose. Check availability of analytes/chemicals for specific tests</p>	<p>Lists the clinical conditions in which CSF, pleural fluid and ascitic fluid will show abnormalities</p> <p>Handles the CSF, pleural fluid and ascitic fluid and perform the requisite biochemical analysis</p>
		Day 1	<p>Process of automation in clinical laboratory, needs and benefits of automation.</p>	2	<p>Demonstration: auto analysers and laboratory information system in action.</p>	3	<p>Outline the process of automation in a clinical laboratory</p> <p>Organize a visit to a fully</p>	<p>Summarise the needs and benefits of automation in clinical laboratory</p> <p>Describes the process flow of</p>

	Week 20					automated laboratory integrated with laboratory information system	an autoanalyzer  Lists the important headings in the laboratory information system software
		Day 2	Laboratory quality control, internal control, external control  Primary standards and secondary standards	2	Quality control tools, making of Levy Jennings chart, Westgard rule application on lab 'control' data	3	Discuss the importance of laboratory control  Highlight the method of internal and external quality control  Arrange for laboratory data for preparation of control charts
		<b>Total HRS</b>		<b>80</b>		<b>120</b>	
<b>Total HRS</b>				<b>200</b>			