

Training Schedule

Vocational Stream

DMLT (Biochemistry 477)

| S. No. | Schedule | | Theory | | Practical | | Instructions to the trainer | Learning outcomes |
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| | 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 |

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| | | | 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 |

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| | | | | | | 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 |

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| | | | 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 |

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| | 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 |

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| | | | | | | | 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 |

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| | 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 |

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| | | | 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 ⁺ , K ⁺ 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 |

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| | 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 |

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| | Week 14 | Day 1 | Hormones: Functional importance of insulin, glucagon, Thyroid hormones, parathyroid hormones, growth hormones | 2 | ELISA, estimation of different hormones (insulin, T ₃ , T ₄ , TSH, free T ₃ , T ₄) 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 |

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| | | | | | 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 - Paper chromatography - Thin layer chromatography | 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: - Immuno electrophoresis - Immune blotting | 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 |

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| | 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 |

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| | | | Immunoturbidimetry & Immunofixation | | | | Agglutination | |
| | Week 19 | Day 1 | <p>Importance of different body fluid analysis:</p> <ul style="list-style-type: none"> - Gastric Juice Analysis` | 2 | <p>Demonstrate the Gastric Juice Analysis:</p> <ul style="list-style-type: none"> - Determination of free and total acidity - Gastric function test | 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"> - Determination of sugar - Determination of proteins - Determination of chloride <p>Pleural/ ascitic fluid analysis</p> <ul style="list-style-type: none"> - Sugar, protein amylase , transudate exudates | 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> |

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| | 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 |
| | | Total HRS | | 80 | | 120 | |
| Total HRS | | | | 200 | | | |