MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WB
Syllabus of M. Sc.in Medical Lab Technology
(Effective for 2022-2023 Admission Session)

SEMESTER - I

MMLT 101-- Structure and Function of Biomolecules (Theory)

Objectives:

1) The objective of this course is that after 50 hours of lectures, demonstrations, practicals and clinics the student will have the knowledge about different types of polysaccharides, proteins, nucleic acid, lipid and vitamins.
2) To demonstrate the different technique of identification of carbohydrates.
3) Summarize the effect of deficiency of vitamins.

Course Outcomes:

1) In this course the student will learn about different types of carbohydrates.
2) In this course the student will learn about different types of protein.
3) In this course the student will learn about different types of nucleic acid.
4) In this course the student will learn about different types of lipid.
5) In this course the student will learn about different types of vitamins.
6) In this course the student will learn the principles, techniques for identification of different types of carbohydrates, protein, lipid and vitamins.

THEORY - MMLT 101

CO	Blooms Level (if applicable)	Unit	%age of questions
1	1,2	I	15
2	1,2	II	15
3	1,2	III	25
4	2,3	IV	25
5	2,3	V	20
			100

PRACTICAL –MMLT 191

CO	Blooms Level (if applicable)	Unit	%age of questions
1			
2			
3			
4			
5			
6	1,2	VI	100
			100

UNIT-I: HOMO AND HETEROGLYCANS

Polysaccharides - occurrence, structure, properties and functions of homoglycans - starch, glycogen,cellulose,dextrin,inulin,chitins,xylans,arabinans,galactans.Occurrence,structure, properties, and functions of heteroglycans - bacterial cell wall polysaccharides, glycosaminoglycan, agar, alginic acid, pectin, amino sugars and deoxv sugars, blood group substances and sialic acids, Glycoprotein and their biological applications, Lectins structure

and functions.

UNIT-II: PROTEINS

Classification of proteins on the basis of solubility and shape, structure, and biological functions, Denaturation and renaturation of proteins, Primary structure - determination of amino acid sequence of proteins, The peptide bond: Ramachandran plot, Secondary structure - weak interactions involved - alpha helix and beta sheet and beta turns structure. Pauling and Corey model for fibrous proteins, Collagen triple helix, Super secondary structures – helix -loop-helix, Tertiary structure - alpha and beta domains, Quaternary structure - structure of haemoglobin, Solid state synthesis of peptides.

UNIT-III: NUCLEIC ACIDS

Nucleotides, nucleosides, Watson - Crick Model of DNA structure. A, B and Z - DNA Cruciform structure in DNA, secondary and tertiary structure of RNA, hnRNA, denaturation, strand separation, significance of nucleotides like ATP, cAMP.

UNIT-IV: LIPIDS

Classification of Lipids, Fatty acids and their physiochemical properties, Structure and properties and biological roles of various complex/simple lipids like phospholipids, sphingolipids, glycolipids and others, Fats and waxes, physicochemical properties and characterization of fats and oil, Chemistry and properties of Sterols and Steroids. Salient features of bacterial and plant lipids

UNIT-V: VITAMINS AND PORPHYRINS

Vitamins - water soluble - thiamine, riboflavin, niacin, pyridoxine, folic acid, ascorbic acid-sources, structure, biochemical functions, deficiency diseases, daily requirements; fat soluble - vitamin A, vitamin D2, vitamin E and vitamin K - sources, structure, biochemical functions, deficiency diseases, daily requirements, Porphyrins the porphyrin ring system, hemoglobin, myoglobin and cytochrome.

Books recommended:

1. Biochemistry by L. Stryer, W.H. Freeman and Co. 5th2002
2. Fundamentals of Biochemistry by Voet and Voet, John Wiley and sons NY (2002).
3. Lehninger's Principle of Biochemistry by David L. Nelson and Michael M. Cox. W. H. Freeman; 4th edition(2004)
4. Text Book of Biochemistry with clinical correlation by Thomas .M. Devlin, John Wiley- Liss, Hobokhen NJ publishers (2006) 5. Biochemistry by Zubey, GL WCB Publishers.

MMLT 191-- Structure and Function of Biomolecules (Practical)

1. Carbohydrate colour reactions.
2. Protein colour reactions.
3. Qualitative and quantitative analysis of sugars.
4. Determination of protein in given sample by Lowry method/Bradford method
5. Determination of acid value, saponification and iodine number of lipid samples.
6. Estimation of Vitamin C in fruit juices
7. Estimation of iron in food stuff by dipyridyl method
8. Estimation of copper in serum by diethyl dithiocarbamate method

MMLT 102 -- Analytical and physical Biochemistry (Theory)

Objectives:

1) The objective of this course is that after 50 hours of lectures, demonstrations, practicals and clinics the student will have the knowledge about different types of experimental methods.
2) To demonstrate the different technique of identification and quantification of protein, hormones.
3) To describe the basics of biophysics.

Course Outcomes:

1) Student will learn the principles, techniques of basic biophysics including Osmosis, Dialysis, Buffer system, Electrolytes.
2) Student will learn the principles, techniques of basic biophysics including thermodynamics.
3) In this course the student will learn the principles, techniques for identification of different types of proteins and hormones.
4) Student will learn the principles and basic laboratory techniques including RIA and ELISA.

THEORY- MMLT 102

CO	Blooms Level (if applicable)	Unit	% age of questions
1	1,2	I	35
2	1,2	II	35
3	1,2	III	30
			100

PRACTICAL –MMLT 192

CO	Blooms Level (if applicable)	Unit	% age of questions
1			
2			
3			
4	1,2	IV	100
			100

UNIT-I

Electrolytes: - Definition, ionization of weak acids, weak bases pH, Henderson- Hassel Balch equation

Buffer systems: -definition, titration curve of weak acids, buffering capacity, physiological buffers, Respiratory and metabolic acidosis and alkalosis.

Osmosis: - definition, osmotic crisis, transportation across membrane by membrane proteins.

Dialysis: - definition, purification of proteins on basis of solubility, size, charge and binding affinity.

UNIT-II

Definitions-viscosity, surface tension, biomedical importance of viscosity and surface tension

BiologicalOxidation&Bioenergetics:-proteinfoldingintermsoffreeenergychanges, Entropy,

Laws of Thermodynamics useful thermodynamic function for understanding enzymes, Biomedical Importance, Redox Potential, Enzymes Involved In Oxidation , Reduction,
High energy linkages:-transport of molecules active and passive, involvement of ATP in biological systems.

UNIT-III

1. Immunoassays : Application to Clinical Biochemistry

a. Radio Immuno-Assays (RIA)
b. Determination of Hormones by Using Radio Immunoassays(RIA)
c. Nonisotopic Immuno Assays
d. Homogeneous Enzyme Immuno Assays
e. Heterogeneous Enzyme Immuno Assays
f. Enzyme Linked Immuno-Sorbant Assay(ELISA)
g. Chemiluminescence & Bioluminescence
h. Micropartical Enzyme Immunoassay(MEIA)
i. Fluorescence Polarization Immunoassay(FPIA)
j. Radio Active Energy attenuation(REA)Assays

Books recommended:

1. Biochemistry by L. Stryer, W.H. Freeman and Co. 5th2002
2. Fundamentals of Biochemistry by Voet and Voet, John Wiley and sons NY (2002).
3. Lehninger's Principle of Biochemistry by David L. Nelson and Michael M. Cox. W. H. Freeman; 4th edition(2004)

MMLT 192-- Analytical and physical Biochemistry (Practical)

1. How to prepare solutions. Normal solution, Molar solution, Molal solution and solutions.
2. Preparation of buffers and measurement of pH.
3. Preparation of Phosphate buffer and determination of pH using Indicator and pH meter
4. Titration of strong and weak acids
5. Determination of pKa
6. Calibration of laboratory pipette/micropipette.
7. Standardization of Distilled water
8. Standardization of an endpoint reaction method
9. Determination of Hormones by Using Radio Immunoassays(RIA)
10. To perform Direct and Indirect ELISA
11. Demonstration of Osmosis and Dialysis

MMLT 103-- Fundamentals of Enzymology Theory

Objectives:

1) To illustrate of general, special and functional enzymology; Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group, activators, inhibitors, active site of enzyme.

2) Students will compare the structures and purposes of basic enzymes of different classes of enzyme kinetics, effect of ph and temperature on enzyme.

3) To Extend the industrial and clinical uses of Enzymes that as analytical reagents, Immobilized enzymes, Biotechnological applications of enzymes, Application of enzymes in medicine and industry.

4) To Interpret Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparginase, streptokinase. Enzymes and isoenzymes in diagnosis, Principles of diagnostic enzymology, clinical significance of alkaline and acid phosphatase, SGOT, SGPT, LDH, CPK, aspartate aminotransferase, alanine aminotransferase, creatine kinase.

Outcomes:

1) On successful course completion students will be able to demonstrate understanding of enzymology and significance of enzymatic reaction diagnostic methods, to describe the enzymatic characteristics, classifications, functions of active sites of enzyme, measurement of enzyme activity etc.
2) After studying this course, you should be able to: list the main components of enzymes, summaries the structure and function of the different enzyme kinetics, outline how cell enzymology is related to cellular function and metabolism, identify the acid base catalysis, covalent catalysis etc.
3) To make an outline of the Michaels Menten equation, its derivation, determination of Km value etc.
4) After studying this course, students will understand the protocols of enzyme kinetics, blood transfusion and different types of blood tests.
5) After studying the students will understand the biotechnological, medicinal, industrial applications of enzymes.

THEORY - MMLT 103

CO	Blooms Level (if applicable)	Unit	% age of questions
1	1,2	I	15
2	1,2	II	15
3	1,2	III	25
4	2,3	IV	25
5	2,3	V	20
			100

PRACTICAL – MMLT 193

CO	Blooms Level (if applicable)	Unit	% age of questions
1			
2			
3			
4			

5			
6	1,2	VI	100
			100

UNIT-I: INTRODUCTION

Introduction to Enzymes: Nomenclature, Classification and Characteristics of enzymes, Enzyme specificity, Cofactors, Co-enzyme and Prosthetic group, activators, inhibitors, active site, metalloenzymes, isozymes, monomeric enzymes, oligomeric enzymes and multienzyme complexes, Units of enzyme activity (definition of IU, Katal), specific activity of enzyme, measurement of enzyme activity, enzyme turnover.

Mechanism of Enzyme Action**:** Nature of active site, identification of functional groups at activesite,enzymesubstratecomplex,Factorsresponsibleforcatalyticefficiencyofenzymes: Proximityandorientation,Covalentcatalysis,Acidbasecatalysis,Strainanddistortiontheory, Induced fit hypothesis, Reversible and irreversible covalent modification, feedback inhibition, control of enzyme by products, substrates and adenylate energy charge, monocyclic and multicyclic cascade systems.

UNIT-II: ENZYME KINETICS

MichaelisMentenequation.DerivationofMichaelisMentenequationanddeterminationofKm and Vmax values, Substrate inhibition and activation, Effect of pH and temperature on rate of enzyme catalyzed reactions, Allosteric enzymes

UNIT-III: ENZYME CATALYSIS AND INHIBITION

Enzyme inhibition: reversible and irreversible inhibition, Kinetics of competitive, uncompetitive and non-competitive inhibition, Mechanism of enzymatic action - general acid-basecatalysis,covalentcatalysis,roleofmetalioninenzymecatalysis,Reversibleinhibition-competitive, uncompetitive, noncompetitive, mixed, substrate and allosteric inhibition, Irreversible inhibition.

UNIT-IV: INDUSTRIAL AND CLINICAL USES OF ENZYMES

Enzymes as analytical reagents, Immobilized enzymes, Biotechnological applications of enzymes, Application of enzymes in medicine and industry.

UNIT-V: CLINICAL ENZYMOLOGY

Clinical enzymology - Enzymes as thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparginase, streptokinase. Enzymes and isoenzymes in diagnosis, Principles of diagnostic enzymology, clinical significance of alkaline and acid phosphatase, SGOT, SGPT, LDH, CPK, aspartate aminotransferase, alanine aminotransferase, creatine kinase.

Books Recommended

1. Palmer T (2001) Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, Horwood Publishing, Chichester, UK
2. Price NC and Stevens L (1999) Fundamentals of Enzymology, 3rd Edition, Oxford University Press Inc., NewYork
3. Berg JM, Tymoczko, JL and Stryer L (2002) Biochemistry, 5th Edition, WH Freeman & Co., NewYork
4. Dixon M and Webb EC (1979) Enzymes, 3rd Edition, Academic Press, NewYork
5. Seigal IH (1975) Enzyme Kinetics, Wiley Interscience,USA

MMLT 193-- Fundamentals of Enzymology (Practical)

1. To demonstrate the effect of substrate concentration on enzymes.
2. To demonstrate the effect of pH on enzymes.
3. To demonstrate the effect temperature on enzymes.
2. Variation of enzyme activity with Enzyme concentration
3. Assay of acid & alkaline Phosphatase and calculation of specific activity.
4. Extraction, partial purification and characterization of an enzyme.
5. Determination of amylase in given sample.
6. Determination of Serum Lipase
7. Determination of Serum Lactate Dehydrogenase (LDH)
8. Estimation of Glutamate Dehydrogenase

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MMLT 104 - Molecular Metabolism - I

Objectives:

1) To develop understanding of general metabolism pathways, glycolysis, glycogenolysis, glycogenesis, neoglucogenesis, TCA cycle, Cori cycle etc.

2) Students will understand the Electron transport chain reaction, regulation of Oxidative phosphorylation, ATP/ADP exchange in mitochondria.
3) To interpret the Oxidation of fatty acids, Biosynthesis and degradation of fatty acids, Metabolism of triglycerides, phospholipids and sphingolipids, Cholesterol - Biosynthesis, regulation, transport and excretion, errors in lipid metabolism.

Outcomes:

1) On successful course completion students will be able to demonstrate understanding of carbohydrate metabolism and significance, to describe the key enzyme regulation pathways of carbohydrate metabolism.
2) After studying this course, you should be able to: list the different cycles of metabolism, identify the glucose conversion processes, understand the ETC reaction in mitochondria, how the electron is been transported from one compound to another, how the F1 particle functions etc.

3) To explain Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, and regulation of signaling pathways.

THEORY - MMLT 104

CO	Blooms Level (if applicable)	Unit	% age of questions
1	1,2	I	25
2	1,2	II	25
3	1,2	III, IV	50

UNIT-I: CARBOHYDRATE METABOLISM

Glycolysis and gluconeogenesis - Pathway, key enzymes of regulation, citric acid cycle and regulation, pentose phosphate pathway, Metabolism of glycogen, galactose and fructose, glycosylate cycle, Cori cycle, anapleroticreactions , Importance of these pathways in clinical biochemistry.

UNIT-II: ELECTRON TRANSPORT CHAIN

The electron transport chain, organization and role in electron capture, Oxidative phosphorylation - Electron transfer reactions in mitochondria, F1F0 ATPase - Structure

and mechanism of action, Inhibitors of respiratory chain and oxidative phosphorylation - Uncouplers and ionophores, Regulation of oxidative phosphorylation, Mitochondrialtransport systems - ATP/ADP exchange, malate / glycerophosphae shuttle, creatine - phosphate shuttle.

UNIT-III: LIPID METABOLISM:

Oxidation of fatty acids, Biosynthesis and degradation of fatty acids, Metabolism of triglycerides, phospholipids and sphingolipids, Cholesterol - Biosynthesis, regulation, transport and excretion, errors in lipid metabolism.

Metabolism of ketone bodies - Formation, utilization, excretion and clinical significance.

UNIT-IV: CELL SIGNALING AND CELLULAR COMMUNICATION:

Cell signaling Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, and regulation of signaling pathways.

Cellular Communication - Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrin

Books Recommended:

1. Abeles RH, Frey PA and Jeneks WP (1992) Biochemistry, Jones and Bartlett Publishers, Boston.
2. Berg JM, Tymoczko, JL and Stryer L (2002) Biochemistry, 5th Edition, WH Freeman & Co., New York.
3. Cohn EE, Stumph PK, Bruening G and Doi RH (1987) Outlines of Biochemistry, 5thEdition, John Wiley & Sons, NewYork.
4. Murray RK, Granner DK, Rodwell VW and Mayes PA (2000) Harper's Biochemistry, 25thEidtion, Applaton and Lange Publications, California,USA.
5. Nelson DL and Cox MM (2001) Lehninger Principles of Biochemistry, 3rd Edition, MacMillon Worth Publishers, New Delhi.
6. Rawn JD (1990) Biochemistry, 2nd Edition, Harpers and Row Publications, NewYork.
7. Voet D and Voet JG (2001) Biochemistry, 3rd Edition, John Wiley & Sons, NewYork.
8. Zubey G (1998) Biochemistry, 4th Edition, WMC Brown Publishers,USA.