Scheme & Syllabus of

Master of Science in Medical Laboratory Science (Biochemistry) M.Sc. MLS (Biochemistry)

Batch 2025 onwards

By

Board of Studies (MLT / MLS)

Department of Academics
IK Gujral Punjab Technical University

IK Gujral Punjab Technical University
M. Sc. MLS (Biochemistry)

Masters of Science in Medical Laboratory Science (M. Sc. MLS):

The mission of the Master in Medical Laboratory Science (Biochemistry) program at Punjab Technical University is to prepare candidates with the knowledge, skills, and professional behaviors needed to function effectively in biochemistry laboratory settings. It is a postgraduate (PG) Programme of 2 years' duration (4 semesters)

Eligibility for Admission: All those candidates who have passed any recognized Bachelor's degree in Medical Lab Technology of minimum three years' duration.

Courses & Examination Scheme:
First Semester

Course Code	Course Type	**Course Title**	**Load Allocations**			**Marks Distribution**		**Total Marks**	**Credits**
			L*	T*	P	Internal	External		
MMLT101-25	Core Theory	Structure and Function of Biomolecules	3	1	0	30	70	100	4
MMLT102-25	Core Theory	Analytical and physical Biochemistry	3	1	0	30	70	100	4
MMLT103-25	Core Theory	Fundamentals of Enzymology	3	1	0	30	70	100	4
MMLT104-25	Core Theory	Intermediary Metabolism- I	3	1	0	30	70	100	4
MMLT105-25	Core Practical/ Laboratory	Structure and Function of Biomolecules	0	0	6	25	50	75	3
MMLT106-25	Core Practical/ Laboratory	Analytical and physical Biochemistry	0	0	6	25	50	75	3
MMLT107-25	Core Practical/ Laboratory	Fundamentals of Enzymology	0	0	6	25	50	75	3
MMLT108-25	Elective Practical	Seminar/Journal club	0	0	2	25	-	25	1
	TOTAL		**12**	**04**	**20**	**220**	**430**	**650**	**26**

Semester-I

IK Gujral Punjab Technical University
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SEMESTER_I

MMLT101-25- Structure and Function of Biomolecules

Theory

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, glycoaminoglycans, agar, alginic acid, pectins, 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. 5th 2002
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.

IK Gujral Punjab Technical University
M. Sc. MLS (Biochemistry)

MMLT102-25-Analytical and physical Biochemistry
Theory

1. Electrolytes: - Definition, ionization of weak acids, weak bases pH, Henderson-Hasselbalchequation
2. Buffer systems: -definition, titration curve of weak acids, buffering capacity, physiological buffers, Respiratory and metabolic acidosis and alkalosis.
3. Osmosis: - definition, osmotic crisis, transportation across membrane by membrane proteins.
4. Dialysis: - definition, purification of proteins on basis of solubility, size, charge and binding affinity.
5. Definitions - viscosity, surface tension, biomedical importance of viscosity and surface tension
6. Biological Oxidation & Bioenergetics: - protein folding in terms of free energy changes, Entropy, Laws of Thermodynamics useful thermodynamic function for understanding enzymes, Biomedical Importance, Redox Potential, Enzymes Involved In Oxidation , Reduction,
7. High energy linkages: - transport of molecules active and passive, involvement of ATP in biological systems.
8. Immunoassays : Application to Clinical Biochemistry

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

MMLT103-25- Fundamentals of Enzymology

Theory

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 active site, enzyme substrate complex, Factors responsible for catalytic efficiency of enzymes: Proximity and orientation, Covalent catalysis, Acid base catalysis, Strain and distortion theory, 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

MichaelisMenten equation. Derivation of MichaelisMenten equation and determination of Km 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 enzymic action - general acid-base catalysis, covalent catalysis, role of metal ion in enzyme catalysis, Reversible inhibition - 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 thromblytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparginase, streptokinase. Enzymes and isoenzymes in diagnosis, Principles of diagnostic enzymology, clinical significance of alkalineand 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., New York
3. Berg JM, Tymoczko, JL and Stryer L (2002) Biochemistry, 5th Edition, WH Freeman & Co., New York
4. Dixon M and Webb EC (1979) Enzymes, 3rd Edition, Academic Press, New York
5. Seigal IH (1975) Enzyme Kinetics, Wiley Interscience, USA

MMLT104-25- Intermediary Metabolism- I

Theory

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, glyoxylate cycle, Cori cycle, anaplerotic reactions , 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, Mitochondrial transport 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,

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, 5th Edition, John Wiley & Sons, New York.
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, New York.
7. Voet D and Voet JG (2001) Biochemistry, 3rd Edition, John Wiley & Sons, New York.
8. Zubey G (1998) Biochemistry, 4th Edition, WMC Brown Publishers, USA.

MMLT105-25- 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 diethyldithiocarbamate method

MMLT106-25- 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 pHmeter
4. Titration of strong and weak acids
5. Determination of pKa
6. Calibration of laboratory pipette/micropipette.
7. Standarization of Distilled water
8. Standardization of an endpoint reaction method
9. Determination of Hormones by Using Radio Immuno assays (RIA)
10. To perform Direct and Indirect ELISA
11. Demonstration of Osmosis and Dialysis

MMLT107-25- 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