

Scheme & Syllabus of

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

Batch 2018 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		
MMLT101-18	Core Theory	Structure and Function of Biomolecules	3	1	--	30	70	100	4
MMLT102-18	Core Theory	Analytical and physical Biochemistry	4	1	-	50	75	125	5
MMLT103-18	Core Theory	Fundamentals of Enzymology	3	0	-	25	50	75	3
MMLT104-18	Core Theory	Intermediary Metabolism- I	3	1	-	30	70	100	4
MMLT105-18	Core Practical/Laboratory	Structure and Function of Biomolecules	-	-	8	25	75	100	4
MMLT106-18	Core Practical/Laboratory	Analytical and physical Biochemistry	-	-	8	25	75	100	4
MMLT107-18	Core Practical/Laboratory	Fundamentals of Enzymology	-	-	8	25	75	100	4
MMLT108-18	Elective Practical	Seminar/Journal club	-	-	2	-	-	100	1
	TOTAL		13	03	26	210	490	800	29

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Second Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
MMLT201-18	Core Theory	Biochemical Techniques	4	1	-	50	75	125	5
MMLT202-18	Core Theory	Clinical Biochemistry-I	4	0	-	30	70	100	4
MMLT203-18	Core Theory	Intermediary Metabolism-II	3	1	-	30	70	100	4
MMLT204-18	Elective Theory	General Physiology & Organ Function Test	3	1	-	30	70	100	4
MMLT205-18	Core Practical/Laboratory	Biochemical Techniques	-	-	8	25	75	100	4
MMLT206-18	Core Practical/Laboratory	Clinical Biochemistry-I	-	-	8	25	75	100	4
MMLT207-18	Elective Theory	General Physiology & Organ Function Test	-	-	6	25	50	75	3
MMLT208-18	Elective practical	Seminar/ Journal club	-	-	2	-	-	100	1
	TOTAL		14	03	24	215	485	800	29

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Third Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
MMLT301-18	Core Theory	Clinical Biochemistry-II	3	1	-	30	70	100	4
MMLT302-18	Core Theory	Applied molecular biology	3	1	-	30	70	100	4
MMLT303-18	Elective Theory	Statistics and clinical biochemistry Laboratory management	3	0	-	25	50	75	3
MMLT304-18	Elective Theory	Automation in the clinical Biochemistry Laboratory	3	0	-	25	50	75	3
MMLT305-18	Core Practical/Laboratory	Clinical Biochemistry-II	-	-	8	25	75	100	4
MMLT306-18	Elective Practical/Laboratory	Automation in the Clinical Biochemistry Laboratory	-	-	8	25	75	100	4
MMLT307-18	Elective Practical/Laboratory	Statistics and clinical biochemistry Laboratory management	-	-	6	25	50	75	3
MMLT308-18	Elective Practical	Seminar/journal club	-	-	2	-	-	100	1
	TOTAL		12	02	24	185	440	725	26

Fourth Semester

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L*	T*	P	Internal	External		
MMLT401-18		Dissertation	Submission within 05 months			150	150	300	12
	TOTAL					150	150	300	12

*A course can either have four Hrs Lecture or Three Hrs Lecture + One Hrs Tutorial as per requirement

Total Marks of M..Sc. Program: 2625

Total Credit of M.Sc. Program: 96

ONLY FOR BOS

The course types and their number are fixed as mentioned in the scheme however respective BOS can shuffle the courses as required.

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Semester-I

SEMESTER_I

**MMLT101-18- 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 deoxy 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 physicochemical 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, Hoboken NJ publishers (2006)
5. Biochemistry by Zubey, GL WCB Publishers.

MMLT102-18-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

MMLT103-18- 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 K_m and V_{max} 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 thrombolytic agents, anti-inflammatory agents, digestive aids. Therapeutic use of asparaginase, 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., 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

**MMLT104-18- 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 / glycerophosphate 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 Jencks 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, 25th Edition, Appleton and Lange Publications, California, USA.
5. Nelson DL and Cox MM (2001) Lehninger Principles of Biochemistry, 3rd Edition, MacMillan Worth Publishers, New Delhi.
6. Rawlins 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.

**MMLT105-18- 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 dipyrldyl method
8. Estimation of copper in serum by diethyldithiocarbamate method

**MMLT106-18- 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

**MMLT107-18- 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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SEMESTER-II

**SEMESTER-II
MMLT201-18- Biochemical Techniques
Theory**

UNIT-I: SPECTROSCOPY

Concepts of spectroscopy, Visible and UV spectroscopy, Laws of photometry, Beer-Lambert's law, Principles and applications of colorimetry.

UNIT-II: ULTRACENTRIFUGATION AND RADIOACTIVITY

Ultracentrifugation - basic principles, Preparative ultracentrifugation - differential centrifugation and density gradient centrifugation, Analytical centrifugation, determination of molecular mass and purity of macromolecules

Radioactivity: Nature of radioactivity - stable and radioactive isotopes - units and interaction of radioactivity with matter, Detection and measurement of radioactivity - GM counter, solid and liquid scintillation counter, Applications of radioisotopes in the biological sciences.

UNIT-III: CHROMATOGRAPHY

Chromatographic techniques: General principles of partition and adsorption chromatography, Thin layer chromatography, column chromatography, Ion - exchange chromatography, molecular exclusion chromatography, gas chromatography, liquid and HPLC, normal phase, reverse phase, chromatofocusing, immunoaffinity, capillary electrochromatography.

UNIT-IV: ELECTROPHORESIS

Principles of electrophoretic separation, Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel, Electroporation, pulse field gel electrophoresis

UNIT-V: SCOPE OF BIOPHYSICAL CHEMISTRY

Fundamentals of Flowcytometry: Basics of technique, Principle, various applications of flowcytometer

**MMLT202-18- Clinical Biochemistry-I
Theory**

UNIT I:

Introduction: Definition and scope of clinical biochemistry in diagnosis, use of clinical laboratory and interpretation of results.

Body Fluids: Biochemistry of urine, blood and cerebrospinal fluid, normal and abnormal constituents and clinical entities in body fluids.

Unit-II

Disorders of Metabolism: Disorders of carbohydrate metabolism: diabetes mellitus, ketoacidosis, hypoglycemia, glycogen storage diseases, galactosemia, lactose intolerance, and lactic acidosis.

Unit-III

Disorders of lipids: lipid mal- absorption and steatorrhea, sphingolipidosis, clinical interrelationships of lipids, lipoproteins and apolipoproteins.

Unit-IV

Disorders of amino acid metabolism: inborn errors of amino acid metabolism-alkaptonuria, phenylketouria, albinism, gout, hyperglycemia, phenylalaninemia, homocystineuria, tyrosinemia, aminoacidurias, disorders of nucleic acid metabolism (Purine and Pyrimidine metabolism),

UNIT-VI

Interrelation of pharmacology and biochemistry, drug detoxification, host-drug interactions, molecular mechanism of action of drugs, medicinal chemistry: phytochemicals of therapeutic value.

Generation of new pharmaceutical modalities: recombinant vaccines, recombinant enzymes, monoclonal antibodies, hormones, cytokines, blood clotting factors, pharmacogenomics, introduction to gene therapy, bio-nanotechnology

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,

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5thEdition, John Wiley & Sons, New York.

4. Murray RK, Granner DK, Rodwell VW and Mayes PA (2000) Harper's Biochemistry, 25thEdition, Appleton 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.
9. Parveen Bansal, S.N. Das (2014) Biotechnology in Medicine and Herbal Drug Development, Ist edition, Gulab publishers.

**MMLT203-18- Intermediary Metabolism- II
Theory**

UNIT-I: METABOLISM OF AMINO ACIDS

General reactions of amino acids metabolism i.e. transamination deamination decarboxylation, Catabolism of individual amino acids, Urea cycle, biosynthesis of essential and non-essential amino acids, Regulation of amino acid biosynthesis, Metabolism of amino acids precursors. Aminoaciduria: a) Definition b) Types of Aminoaciduria: Overflow Aminoaciduria, Renal Aminoaciduria

UNIT-II: METABOLISM OF PORPHYRINS AND NUCLEOTIDES

Metabolism of Porphyrins: Biomedical importance, Heme biosynthesis, catabolism of heme bilirubin, Hyperbilirubinoemia, Degradation of purines and pyrimidines, Salvage pathways, Biosynthesis of purine and pyrimidine nucleotides, Biosynthesis of deoxyribonucleotides, Biosynthesis of nucleotide coenzymes, Regulation of nucleotide biosynthesis.

Unit-III: Intrinsic Disorders of Red Cells

Haemoglobin and Porphyrins Sphingolipidases: a) Disorders of Red Cells: Hemolytic Anemia, Sickle Cell Anemia, Thalassaemia, b) Disorders of Hemoglobin Haemoglobinuria, Other Haemoglobinuriopathies, c) Disorders of Porphyrins 1. Introduction 2. Porphyria : Definition and types 3. ALA Dehydratase Deficient Porphyria 4. Acute Intermittent Porphyria

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, 25th Edition, 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.

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8. Zubey G (1998) Biochemistry, 4th Edition, WMC Brown Publishers, USA.

MMLT204-18- General Physiology and Organ Function Test
Theory

Unit-I: Digestion and Absorption of food

Digestion and absorption of carbohydrates, Proteins, Lipids, Nucleic acids, Absorption of Electrolytes, Absorption of Vitamins, Absorption of Water

UNIT-II: Respiration

Lung volume and capacities, Internal and external respiration, Transport of oxygen and carbon dioxide, Muscle contraction Sliding filament contractions, The contraction cycle, Excitation-contraction coupling

UNIT-III BLOOD CLOTTING

Chemistry of blood coagulation and coagulation disorders

UNIT-IV: MINERALS AND THEIR ROLE IN NUTRITION

Minerals and trace elements - Source, function and importance

UNIT-V: NUTRITION IN HEALTH AND DISEASE

Balanced diet-Regulations of food intake and energy storage, Disorder of nutrition- Malnutrition, malabsorption, obesity, starvation, deficiency diseases

UNIT-VI: ORGAN FUNCTION TEST

Thyroid function test, Renal Function test, Liver Function Test and Gastric Function Tests, Cardiac Function test (Enzyme based)

Books Recommended:

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

MMLT205-18- Biochemical Techniques

Practical

1. Demonstration of principle and procedure of Column chromatography
2. Separation of Amino Acids by Ion – exchange Chromatography
3. Separation of Proteins by Two – dimensional Paper Chromatography
4. Separation of Proteins by Ion- Exchange Chromatography
5. Demonstration of Adsorption Chromatography
6. Separation of Amino Acids by Paper Electrophoresis
7. Separation of Lipids by Thin layer chromatography
8. Separation of Serum Proteins SDS –gel Electrophoresis
9. UV Absorption of Proteins & Amino acids
10. Demonstration of principle and use of flame photometer
11. Demonstration of principle and use of Spectrophotometer

**MMLT206-18- Clinical Biochemistry-I
Practical**

- **Estimation and standardization of**
 - a) Glucose
 - b) Urea
 - c) Cholesterol
 - d) Triglycerides
 - e) Phospholipids
 - f) Total Lipids
 - g) Uric Acid
 - h) Creatinine
 - i) Ketone Bodies
 - j) Glycosylated Haemoglobin
 - k) Bilirubin
 - l) Myoglobin

- Estimation of porphyrins and porphobilinogen in urine.
- Urine quantitative and qualitative analysis: Random and 24 hours

**MMLT207-18- General Physiology and Organ Function Test
Practical**

- Thyroid Function Test
- Renal function Test
- Liver Function test
- Gastric and pancreatic Function Test
- Arterial Blood gas Analyser: working and its uses
- Stone analysis
- Tumor markers
- Estimation of Heavy metals- Copper, Zinc, Cadmium, Iron, Aluminum, Mercury, Arsenic, Lead etc.
- Biological fluids: cerebrospinal fluid analysis
- Body fluid analysis: biochemical analysis of peritoneal fluid, pleural fluid, synovial fluid, ascetic fluid, semen, amniotic fluid
- Cardiac function Test (enzyme based)

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SEMESTER-III

**Semester-III
MMLT301-18- Clinical Biochemistry-II
Theory**

UNIT-I

Biological materials- Methods of estimation, normal range in blood serum, plasma and Urine of Glucose, Proteins, Urea, Uric acid, Creatinine, Cholesterol, Quality control & standardization.

UNIT-II

Enzymes: Methods of estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of: SGOT, SGPT, Alkaline phosphatase, Acid phosphatase, Amylase, CPK.

Mineral estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of : Na, K, Ca, Cl, P, Iodine, Nitrogen, Zn, Mg, Li.

UNIT-II

Hormones: Methods of estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of: Androgens, Pregnenolone, estrogens, corticosteroids, catecholamine, thyroid, prolactin, growth hormones. FSH,LH, testosterone, β -HCG.

UNIT-IV

Vitamins-Methods of estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of: Vitamin A, thiamine, Niacin, Pyridoxine, Ascorbic acid, Vitamin D₃

Others- Methods of estimation, principles of assay, normal range in tissues and clinical conditions leading to abnormal levels of Barbiturates, Urobilinogen, Opiates, organophosphorus.

MMLT302-18- Applied Molecular Biology

Theory

UNIT-I ORGANIZATION OF GENOME

Satellite DNA, Structure of Gene Regulation of Gene Expression, Gene Expression by Genetic Recombination, Regulation of Gene Expression in Yeast (Eukaryotes), Auto regulation, Hormonal Regulation Genetic Coding

UNIT-II MUTATION

Various types of Mutation, Spontaneous Mutation, Induced Mutation, Applications of Mutation Linkage, Crossing-Over and Chromosome mapping

UNIT III: TOOLS OF GENETIC ENGINEERING

Restriction endonucleases, DNA ligase, DNA polymerase I, reverse transcriptase, S1 nuclease, Alkaline phosphatase, Plasmid, bacteriophage and cosmids as vehicles of cloning, Use of linkers, adapters, homopolymer tailing in creating recombinant DNA molecules. Cloning strategies and selection of recombinants:

Cloning Strategies: Cloning from mRNA, genomic DNA, gene libraries.

UNIT-IV: BASIC TECHNIQUES

Isolation Handling and quantification of Nucleic acids, agarose gel electrophoresis, Preparation of labelled DNA probes, Southern blotting. Northern blotting. DNA sequencing DNA finger printing, Polymerase chain reaction, site directed mutagenesis, Transformation, Transfection.

UNIT-IV: APPLICATION OF RECOMBINANT DNA TECHNOLOGY

In Medicine: Molecular diagnostics, vaccines, drugs, gene therapy.

In Forensic Science: Minisatellite DNA, inheritance of repetitive DNA, inheritance of RFLP.

Books Recommended

1. Primrose SB, Twyman RM and Old RW (2001) Principles of Gene manipulation, 6th Edition, Blackwell Scientific Publication, Oxford, UK.
2. Wastson JD, Tooze J and Kurtz DT (1991) Recombinant DNA A Short Course, 2nd Edition, W.H. Freeman and Company, New York.
3. Brown TA (2001) Gene Cloning and DNA Analysis, An Introduction, 4th Edition, Blackwell Scientific Publication, Oxford, UK.
4. Christopher Howe (1995) Gene Cloning and Manipulation, Cambridge University Press,

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New York.

5. Dale JW, Schantz MU (2002) From Genes to Genomes: Concepts and Applications of DNA Technology, John Wiley & Sons, New York.
6. Micklos DHA, Freyer GA, Crotty DA and Freyer G (2002) DNA Science: A First Course in DNA Technology, 2nd Edition, Cold Spring Harbor Lab Press, New York.

MMLT304-18- Automation in the Clinical Biochemistry Laboratory
Theory

- a. Various types of Autoanalyzers: Semi-automated, Fullyautomated analyzers
- b. Reagents and Kits for Autoanalyzers
- c. ELISA reader and ELISA washer
- d. Colorimeter and Spectrophotometer
- e. Flowcytometer: use in cancer marker detection
- f. Vaccitainers
- g. Cold chain refrigeration
- h. Use of Laboratory centrifuges in clinical biochemistry lab
- i. Chemiluminiscence
- j. PCR/RTPCR
- k. Validation of the Machine
- l. Sources of Error
- m. Quality Assurance and Quality Control
- n. Tumor markers : CEA, AFP (α - β proteins),
- o. Serum Urine and Hb electrophoresis

MMLT303-18- Statistics and clinical biochemistry Laboratory management

Statistics

1. Importance Of statistical methods in clinical biochemistry
2. Collection, classification & Presentation of Data-Graphs, Diagrams & Tables
3. Population & Sample & Sampling Techniques
4. Analysis of Data averages-Mean, Mode & Median
5. Variance & standard Deviation
6. Correlation
7. Additivity of Means & Variance
8. Regression
9. Hypothesis-Meaning, Testing of Hypothesis using t-Test, Chi-square Test & Test for ANOVA

Laboratory Management

1. Quality Control and quality assurance in clinical biochemistry
2. Selection & Storage of Chemical Materials & Apparatus
3. Collection, preservation and transportation of clinical samples
4. Care and maintenance of General Laboratory Apparatus
5. Calibration of Volumetric Apparatus
6. Storage, Handling & disposal of Infected, Radioactive & Dangerous Materials
7. Safety Measures & Emergency Treatments for Accidents
8. Protocol development for accreditation of clinical biochemistry lab

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**MMLT305-18- Clinical Biochemistry-II
Practical**

1. Determination of Electrolytes
2. Determination of Amylase
3. Determination of LH, FSH and Prolactin
4. Determination of Progesterone, Estrogens, Corticosteroids, Prolactin, Growth hormones, FSH, LH, Testosterone, β -HCG.

**MMLT306-18- Automation in the Clinical Biochemistry Laboratory
Theory**

- Various types of Autoanalyzers: Semi-automated, Fullyautomated analyzers
- Reagents and Kits for Autoanalyzers
- ELISA reader and ELISA washer
- Colorimeter and Spectrophotometer
- Flowcytometer: use in cancer marker detection
- Vaccitainers
- Cold chain refrigeration
- Use of Laboratory centrifuges in clinical biochemistry lab
- Chemiluminiscence
- PCR/RTPCR
- Validation of the Machine
- Sources of Error

**MMLT307-18- Statistics and clinical biochemistry Laboratory
management
Practical**

- Demonstration of use of statistical methods in quality control of routine biochemistry parameters.
- Sampling techniques
- Sample storage
- Transportation of samples
- Safety and sample handling
- Third party quality control
- First aid and emergency facilities in the laboratory
- Standardization of 0.1 ml volumetric pipette.
- Preparation of protein free filtrates of blood.
- Separation of serum from clotted blood..
- Standardization of a photometer/spectrometer.
- Calibration of instruments used in clinical biochemistry