

**MRSPTU M. Sc. MEDICAL LABORATORY SCIENCE SYLLABUS 2016 BATCH  
ONWARDS**

(Approved in 1<sup>st</sup> MRSPTU Standing Committee of Academic Council on 20.12.2016)

**M. Sc. MEDICAL LABORATORY SCIENCE (1<sup>st</sup> YEAR)**

**Total Contact Hours = 23**

**Total Marks = 700**

**Total Credits = 21**

SEMESTER 1 <sup>st</sup>		Contact Hrs			Marks			Credits
Subject Code	Subject Name	L	T	P	Int.	Ext.	Total	
MMLS1-101	Physical Biochemistry	4	0	0	40	60	100	4
MMLS1-102	Enzymes & Metabolism- I	4	0	0	40	60	100	4
MMLS1-103	Clinical Biochemistry- I	4	0	0	40	60	100	4
MMLS1-104	Physiology & Nutrition-I	4	0	0	40	60	100	4
MMLS1-105	Biostatistics	3	0	0	40	60	100	3
MMLS1-106	Clinical Biochemistry- I Lab	0	0	2	60	40	100	1
MMLS1-107	Biostatistics Lab	0	0	2	60	40	100	1
<b>Total</b>	<b>Theory = 5 Labs = 2</b>	<b>19</b>	<b>0</b>	<b>4</b>	<b>320</b>	<b>380</b>	<b>700</b>	<b>21</b>

**Total Contact Hrs. = 24**

**Total Marks = 700**

**Total Credits= 22**

SEMESTER 2 <sup>nd</sup>		Contact Hrs			Marks			Credits
Code	Name	L	T	P	Int.	Ext.	Total	
MMLS1-208	Analytical Biochemistry	4	0	0	40	60	100	4
MMLS1-209	Enzymes & Metabolism- II	4	0	0	40	60	100	4
MMLS1-210	Physiology & Nutrition-II	4	0	0	40	60	100	4
MMLS1-211	Clinical Biochemistry-II	4	0	0	40	60	100	4
MMLS1-212	Molecular Diagnostics	4	0	0	40	60	100	4
MMLS1-213	Analytical Biochemistry Laboratory	0	0	2	60	40	100	1
MMLS1-214	Clinical Biochemistry-II Laboratory	0	0	2	60	40	100	1
<b>Total</b>	<b>Theory = 5 Labs = 2</b>	<b>20</b>	<b>0</b>	<b>4</b>	<b>320</b>	<b>380</b>	<b>700</b>	<b>22</b>

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**PHYSICAL BIOCHEMISTRY**

Subject Code: MMLS1- 101

L T P C  
4 0 0 4

Duration: 45 Hrs

**Learning Objectives**

To make aware the students regarding various cell organelles and their functioning with special stress on human chromosome.

**UNIT-I (13 Hrs)**

**Kinetics Mechanics:** Chemical and Biochemical Kinetics-General Kinetics. Differential and Integrated Rate Laws, Mechanisms of Chemical and Biochemical Reactions, Enzyme Kinetics, Transition State Theory. Diffusion-Limited Processes, Kinetics Methods in Biochemistry. Diffraction, Scattering. X-Ray, Electron, Neutron Diffraction, Crystal Structures, Space Symmetry Groups. Methods for Bimolecular Structure Determination

**UNIT-II (11 Hrs)**

**Statistical Thermodynamics:** Configurations, Micro and Macro states, The Boltzmann Distribution. The Concept of Partition Function, The Concept of Ensemble from Partition Functions to Thermodynamic Functions. Applications to Binding Equilibria, Single and Multi-Component Systems, Phase Transitions, Statistical Mechanics of Biomolecules as Polymer Chains. Helix-Coil Transition, Protein Folding.

**UNIT-III (9 Hrs)**

**Methods for the Separation and Characterization of Macromolecules:** Description of Diffusion, Coefficient, Fractional Coefficient within Cells, Measuring Diffusion of Small DNA Molecules in Cells, Moving Boundary Sedimentation, Zonal Sedimentation and Equilibrium.

**UNIT-IV (11 Hrs)**

**Macromolecules in Solution; Thermodynamics and Equilibria:** Partial Molar Quantities: The Chemical Potential and Concentration of Ideal and Non ideal Solutions, Applications of The Chemical Potential to Physical Equilibria, Membrane, Sedimentation Equilibrium.

**Recommended Books**

1. Peter Atkins, Julio de Paula, 'Physical Chemistry', Either complete book or *Volume 2: Quantum Chemistry, Spectroscopy and Statistical Thermodynamics*, 8<sup>th</sup> Edn., W.H. Freeman & Co, New York.
2. David Eisenberg, Donald Crothers, 'Physical Chemistry with Applications to the Life Sciences', Benjamin/Cummings Publishing Co.
3. E. Kensal, W. Van Holde, P. Curtis Johnson, Ho Shing, 'Principles of Physical Biochemistry', Pearson Prentice Hall.

**ENZYMES & METABOLISM-I**

Subject Code: MMLS1-102

L T P C  
4 0 0 4

Duration: 45 Hrs

**Learning Objectives**

Students will learn about the role of various enzymes as well as their mechanism in metabolic processes.

**UNIT-I (9 Hrs)**

**Introduction to Enzyme & Mechanism of Catalysis:** Classification and Characteristics, Nature of Active Site, Enzyme Substrate Complex, Factors Responsible for Catalysis, Allosteric Enzymes, Regulation of Metabolic Pathways, Isozymes & Their Importance.

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**UNIT-II (13 Hrs)**

**Enzyme Kinetics:** A Brief Concept of Bioenergetics and Kinetics, Kinetics of Single and Bi-Substrate Enzyme Catalysed Reactions, Michaelis Menten Equation. Derivation of Michaelis Menten Equation and Determination of  $K_M$  and  $V_{MAX}$  Values, Enzyme Inhibition: Reversible and Irreversible Inhibition.

**UNIT-III (15 Hrs)**

**Carbohydrate Metabolism:** Digestion and Absorption of Carbohydrates, Glycolysis, and Citric Acid Cycle, Oxidative Phosphorylation, Gluconeogenesis, Biosynthesis & Degradation of Di and Polysaccharides.

**UNIT-IV (11 Hrs)**

**Lipid Metabolism:** Digestion and Absorption of Lipids Transport of Lipoproteins, Oxidation of Fatty Acids, Degradation and Synthesis of Fatty Acids, Triacylglycerols, Phosphoglycerides, Sphingolipids, and Cholesterol.

**Recommended Books**

1. T. Palmer and P.L. Bonner, 'Enzymes: Biochemistry, Biotechnology and Clinical Chemistry', 2<sup>nd</sup> Edn., Woodhead Publishing, 2007.
2. J.M. Berg, J.L. Tymoczko, G.J. Gatto and L. Stryer, L, 'Biochemistry', 8<sup>th</sup> Edn., W.H. Freeman & Co., New York, 2015.
3. D.L. Nelson and M.M. Cox, 'Lehninger Principles of Biochemistry', 6<sup>th</sup> Edn., Macmillan Worth Publishers, New Delhi, 2013.
4. D. Voet, J.G. Voet and C.W. Pratt, 'Fundamentals of Biochemistry', 5<sup>th</sup> Edn., John Wiley & Sons. New York, 2011.

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**CLINICAL BIOCHEMISTRY - I**

**Subject Code: MMLS1- 103**

**L T P C  
4 0 0 4**

**Duration: 45 Hrs**

**Learning Objectives**

Students will learn the clinical aspects of the biochemistry.

**UNIT-I (13 Hrs)**

**Disorders of Carbohydrates & Lipids Metabolism:** Diabetes Mellitus, Glycohemoglobins, Hypo-Glycemias, Galactosemia and Ketone Bodies, Various Types of Glucose Tolerance Tests, Glycogen Storage Diseases, Plasma Lipoproteins, Cholesterol, Triglycerides & Phospholipids in Health and Disease, Hyperlipidaemia, Hypolipoproteinaemia, Gaucher's Disease, Tay-Sach's and Niemann-Pick Disease, Abetalipoproteinemia

**UNIT-II (9 Hrs)**

**Hormonal Disturbance:** Protein Hormones (Anterior Pituitary Hormones, Posterior Pituitary Hormones), Steroid Hormones, Adrenocorticosteroids and Reproductive Endocrinology. Disturbances in Thyroid Function

**UNIT-III (9 Hrs)**

**Electrolytes, Acid- Base Balance & Digestive Diseases:** Regulation of Electrolyte Content of Body Fluids and Maintenance of pH, Reabsorption of Electrolytes, Maldigestion, Malabsorption, Creatorrhoea, Diarrhoea and Steatorrhea

**UNIT-IV (12 Hrs)**

**Biochemical Aspects of Haematology, Liver & Kidney:** Disorders of Erythrocyte Metabolism, Hemoglobinopathies, Thalassemia Thrombosis and Anaemias. Laboratory Tests to Measure Coagulation and Thrombolysis, Jaundice, Fatty Liver, Normal and Abnormal Functions of Liver and Kidney, Inulin and Urea Clearance.

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**Recommended Books**

1. M.N. Chatterjea and Rana Shinde, 'Textbook of Medical Biochemistry', Jaypee Brothers.
2. John W. Baynes and Marek Dominiczak, 'Medical Biochemistry (Paperback)', Moseby Publishers.
3. Allan Gaw, 'Clinical Biochemistry: An Illustrated Colour Text (Paperback)', 3<sup>rd</sup> Edn.
4. Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James Shepherd, Churchill Livingstone.
5. G. Beckett, S. Walker, P. Rae, P. Ashby, 'Clinical Biochemistry', 7<sup>th</sup> Edn., Blackwell Publishing.

**PHYSIOLOGY & NUTRITION-I**

**Subject Code: MMLS1- 104**

**L T P C  
4 0 0 4**

**Duration: 45 Hrs**

**Learning Objectives**

Students will learn the physiological and nutritional aspects of the human body

**UNIT-I (12 Hrs)**

**Cellular Physiology & Biochemical aspects of Tissues:** Body Fluid Compartments, Membrane Potential, Inter and Intra Cellular Communication, Homeostasis, Electrolytes Contents, Functions of Sodium, Potassium, Chloride and Their Absorption & Transportation, Hydrogen Ion Balance; Structure, Chemical Composition Functions of Muscles, Nerves and Sensory Tissues.

**UNIT-II (13 Hrs)**

**Respiration:** Functional Anatomy of Air- Passages and Lungs, Respiratory Muscles, Mechanics of Respiration- Intrapleural and Airway Pressures, Lung Volumes and Capacities Dead Space, Alveolar Ventilation Transport of Gasses- O<sub>2</sub> Dissociation and CO<sub>2</sub> Dissociation Curves, Gas Exchange- Diffusion and Gases Across Alveolo- Capillary Membrane, Ventilation- Perfusion Ratio, Control of Breathing

**UNIT-III (9 Hrs)**

**Gastro- Intestinal System:** Mastication and Swallowing, Salivary Secretion and Its Regulation, Gastric Secretion and Motility, Function and Regulation of Bile Secretion, Intestinal Secretion and Motility- Regulation (Including Defection).

**UNIT-IV (12 Hrs)**

**Human Nutrition & Dietetics:** Energy Value of Foods- Direct and Indirect Colorimetry- Respiratory Quotient- Energy Needs of the Body- Basal Metabolism Calculation of Total Caloric Requirements, Recommended Dietary Allowances (RDA) Protein Efficiency Ratio, Nutritional and Food Requirements to Meet the Needs of Infants, Adolescents, Adults.

**Recommended Books**

1. E.P. Widmaier, H. Raff, K.T. Strang, Vander, Sherman, Luciano, 'Human Physiology: The Mechanisms of Body Function', 9<sup>th</sup> Edn., Mcgraw- Hill.
2. L.K. Mahan, Krause, 'Food, Nutrition and Diet Therapy', 11<sup>th</sup> edn., Saunders Publishers.
3. C.W. Sutor, M.F. Crowely, 'Nutrition Principles and Applications in Health Promotion', 2<sup>nd</sup> Lippincott Williams and Wilkins.
4. G.A. Spiller, 'CRC Handbook of Dietary Fiber in Human Nutrition', 3<sup>rd</sup> Edn., CRC Press.
5. G.H. Bell, J.N. Davidson and H. Scarborough, 'Textbook of Physiology and Biochemistry', 3<sup>rd</sup> Edn., Livingstone Ltd.

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**BIOSTATISTICS**

**Subject Code: MMLS1- 105**

**L T P C  
4 0 0 4**

**Duration: 36 Hrs**

**Learning Objectives**

Students will understand the various aspects of biostat and its importance in the medical sciences.

**UNIT-I (10 Hrs)**

**Introduction to Statistics:** Biological Data Types, Accuracy and Significant Figures, Frequency Distribution and its Graphical Representations, Sampling, Measures of Central Tendency, AM, GM, HM, QM, Median, Quartiles and Quantiles, Mode, Measures of Dispersion and Variability, Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, Coefficient of Variation, Shannon-Wiener Diversity Index.

**UNIT-II (8 Hrs)**

**Probability and Distributions:** Permutations, Combinations, Probability, Addition and Multiplication of Probabilities, Binomial Distribution, Poisson Distribution, Normal Distribution, Symmetry and Kurtosis of Normal Distribution Curve, Proportions of Normal Distribution.

**UNIT-III (10 Hrs)**

**Hypothesis Testing:** Introduction to Statistical Hypothesis Testing, Significance Level and Critical Value, Type I and Type II Errors, Power of Statistical Test, One and Two Tailed Tests, Confidence Interval, Parametric and Non-Parametric Tests. One Sample, Two Sample and Paired Sample T-Tests, Mann Whitney Test and Wilcoxon Paired Sample Test, Variance Ratio Test.

**UNIT-IV (8 Hrs)**

**Multiple Sample Hypothesis:** Single Factor and Two Factor ANOVA, Multiple Comparison Tests, Tukey Test, SNK, Chi-Square Test, Simple Linear Regression, Coefficient of Correlation, Coefficient of Determination and Rank Correlation, Contingency Tables, Relative Risk Ratio and Odds Ratio.

**Recommended Books**

1. J.H. Zar, 'Biostatistical Analysis', 5<sup>th</sup> Edn., Pearson Education.
2. K.V. Rao, 'Biostatistics-A Manual of Statistical Methods for Use in Health, Nutrition and Anthropology', 2<sup>nd</sup> Edn., Jay Pee Brothers.

**CLINICAL BIOCHEMISTRY-I LABORATORY**

**Subject Code: MMLS1-106**

**L T P C  
0 0 2 1**

**Duration: 36 Hrs.**

1. Determination of Serum and Urine Creatinine, Serum Bilirubin, Serum Chloride
2. Estimation of Blood Urea by Nesslerization Method
3. Estimation of Serum Cholesterol
4. Determination of Serum Uric Acid by Henry Caraway's method
5. Estimation of Serum amylase
6. Glucose Tolerance Test
7. Colorimetric Determination of Calcium in Food

**Recommend Books**

1. G.P. Talwar, 'Text Book of Biochemistry & Human Biology'.

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2. Linten, 'Nutritional Biochemistry & Metabolism'.
3. M.E. Skills and V.R. Yong, 'Modern Nutrition in Health & Diseases'.
4. W.J. Marshall and S.K. Angert, 'Clinical Biochemistry-Metabolic and Clinical Aspects'.
5. T. Devli, 'Biochemistry with Clinical Correlation'.

**BIostatISTICS LABORATORY**

**Subject Code: MMLS1-107**

**L T P C  
0 0 2 1**

**Duration: 24 Hrs**

1. Calculation of AM, GM, HM, QM of Given Raw Data. Also Plot Frequency Polygon and Bar Graph of the Raw as well as Classified Data
2. Determine Median, Mode, Range, Quartile Deviation, Mean Deviation, Standard Deviation and Coefficient of Variation for The Give Set of Data
3. Determining Shannon-Wiener Diversity Index
4. Determine Binomial and Poisson Probability Distributions
5. To Plot Normal Density Function
6. Hypothesis Test Problems Based on Normal Distribution, Two Sample Test and Paired T-Test
7. ANOVA Based Problems and Extension into Tukey Test Problem
8. Problems Based on Mann Whitney Test and Wilcoxon Paired Sample Test
9. Problem Based on Test of Goodness by Chi Square Test
10. Correlation, Regression and Rank Correlation Based Problems
11. Problems Based on Contingency Tables
12. Odds Ratio and Relative Risk Ratio

**Recommended Books**

1. J.H. Zar, 'Biostatistical Analysis', 5<sup>th</sup> Edn., Pearson Education.
2. K.V. Rao, 'Biostatistics-A. Manual of Statistical Methods for Use in Health, Nutrition and Anthropology', 2<sup>nd</sup> Edn., Jay Pee Brothers.

**ANALYTICAL BIOCHEMISTRY**

**Subject Code: MMLS1-208**

**L T P C  
4 0 0 4**

**Duration: 45 Hrs.**

**UNIT-I (8 Hrs)**

**Electrochemical Analysis**

The concepts of pH, dissociation and ionization of acids and bases, pKa, buffers and buffering mechanism, Henderson Hasselbalch equation, dissociation of amino acids and determination of pKa; Principle and Applications of Biosensors.

**UNIT-II (12 HRs)**

**Chromatography & Electrophoresis**

Principles, Instrumentations and applications of High-performance liquid chromatography, Adsorption chromatography, Ion-exchange chromatography, Gas chromatography; Electrophoresis of proteins- SDS- PAGE, 2D- PAGE, native gels and nucleic acids.

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**UNIT-III (20 Hrs)**

**Spectroscopy & Radioactivity**

Principle, Instrumentations and applications of Ultraviolet and visible light spectroscopy, Fluorescence spectroscopy, Luminometry, Atomic spectroscopy. 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; Autoradiography. Applications of radioisotopes in the biological sciences.

**UNIT-IV (5 Hrs)**

**Immunoassays**

Radio Immuno- Assay (RIA), Homogeneous Enzyme Immuno Assays, Heterogeneous Immuno Assays, ELISA (indirect, direct, competitive), Chemiluminescence, Elispot assay, Western Blotting.

**Recommended Books**

1. Rajan Katoch, 'Analytical techniques in Biochemistry and Molecular Biology', Springer 2011.
2. Martin Holtzhauer, 'Basic Methods for the Biochemical Lab', Springer, 2007.
3. Keith Wilson and John Walker, 'Principles and Techniques of Biochemistry and Molecular Biology', 7<sup>th</sup> Edn. Cambridge University Press, 2010.
4. S.B. Primrose, R.M. Twyman, and R.W. Old, 'Principles of Gene Manipulations', 6th Edn., Blackwell Science, 2012.
5. Walker and Gastra, 'Techniques in Molecular Biology', Croom Helm, 1983.
6. J.A.A. Chambers and D. Rickwood, 'Biochemistry Lab Fax', Blackwell Science, 1993.
7. S.L.V. Harris and Angal IRL, 'Protein Purification Applications', Press, 1990.
8. 'Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work', Vol. I & II, North Holland, 1969.
9. Cornish Bowden, 'Basic Mathematics for Biochemists', Oxford University Press, 1998.

**ENZYMES & METABOLISM- II**

**Subject Code: MMLS1-209**

**L T P C  
4 0 0 4**

**Duration: 45 Hrs.**

**UNIT-I (12 Hrs)**

**Integration of Metabolism**

Recurring motifs in biochemistry, regulation of major metabolic pathways, metabolic fates of glucose-6-phosphate, pyruvate and acetyl CoA, Metabolic profiles of brain, muscle, adipose tissue, liver and kidney, Hormonal regulation of metabolism, metabolic adaptations.

**UNIT-II (8 Hrs)**

**Metabolism of Nitrogen Compounds**

Digestion and absorption of proteins, Nitrogen fixation and its mechanism, Assimilation of ammonia, Nitrogen cycle.

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**UNIT-III (12 Hrs)**

**Anabolism & Catabolism of Amino Acids**

Biosynthesis of essential and non-essential amino acids, Regulation of amino acid biosynthesis, Metabolism of amino acids precursors; General reactions of amino acids metabolism i.e. transamination deamination decarboxylation, Urea cycle, Catabolism of individual amino acids.

**UNIT-IV (13 Hrs)**

**Biosynthesis & Degradation of Nucleotides**

Biosynthesis of purine and pyrimidine nucleotides, biosynthesis of deoxyribonucleotides and nucleotide coenzymes, Regulation of nucleotide biosynthesis. Degradation of purines and pyrimidines, Salvage pathways.

**Recommended Books**

1. D.L. Nelson and M.M. Cox, 'Lehninger Principles of Biochemistry', 6<sup>th</sup> Edn., Macmillan Worth Publishers, New Delhi, 2006.
2. J.M. Berg, J.L. Tymoczko and L. Stryer, 'Biochemistry', 7<sup>th</sup> Edn., WH Freeman & Co., New York, 2012.
3. R.K. Murray, D.A. Bender, K.M. Botham, P.J. Kennelly, V.W. Rodwell and P.A. Weil 'Harper's Biochemistry', 29<sup>th</sup> Edn., McGraw-Hill Medical Canada, 2012.
4. D. Voet D, J.G. Voet and C.W. Pratt, 'Fundamentals of Biochemistry', 5<sup>th</sup> Edn., John Wiley & Sons. New York, 2011.

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**PHYSIOLOGY & NUTRITION- II**

**Subject Code: MMLS1-210**

**L T P C  
4 0 0 4**

**Duration: 45 Hrs.**

**UNIT-I (12 Hrs)**

**Carbohydrates & Lipids**

Classification, sources and functions of carbohydrates and fats, their absorption, utilization and storage, digestion, absorption, hormonal regulation of blood glucose; dietary fiber, disadvantages of dietary fibers; role of saturated fat, cholesterol, lipoprotein and triglycerides and EFA in the diet.

**UNIT-II (15 Hrs)**

**Proteins & Nucleic Acids**

Classification, sources, functions, digestion, absorption, utilization and storage, protein quality evaluation, nutritional classification of amino acids and their balance and imbalance, toxicity; Structure of nucleoside, nucleotide. De novo and salvage pathways of nucleotide synthesis.

**UNIT-III (8 Hrs)**

**Hormones**

Mode of action, functions of hormones of the endocrine glands- Pituitary, adrenal, thyroid, gonadal hormones, pineal body and parathyroid, hypo and hyper functions of the glands.



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**UNIT-IV (10 Hrs)**

**Vitamins & Minerals**

Chemistry, functions, physiological action, digestion and absorption of vitamins, interaction of fat and water soluble vitamins with other nutrients, hypo and hypervitaminosis; major trace minerals, their bound forms and functions.

**Recommended Books**

1. E.P. Widmaier, H. Raff, K.T. Strang, Shreman Vander, Luciano, 'Human Physiology: The Mechanisms of Body Function', 9<sup>th</sup> Edn., Macgraw- Hill
2. L.K. Mahan and Krause, 'Food, Nutrition and Diet Therapy', 11<sup>th</sup> Edn., Saunders Publishers.
3. C.W. Sutor, M.F. Crowely, 'Nutrition Principles and Application in Health Promotion, 2<sup>nd</sup> Edn., Lippincott Williams and Wilkins.
4. G.A. Spiller, 'CRC Handbook of Dietary Fiber in Human Nutrition', 3<sup>rd</sup> Edn., CRC Press.
5. G.H. Bell, J.N. Davidson, and H. Scarborough, 'Textbook of Physiology and Biochemistry', 3<sup>rd</sup> Edn., Livingstone Ltd.
6. A.B.S. Mahapatra, 'Essentials of Medical Physiology', Current Books International Publishers.
7. Z. Kroner, 'Vitamins and Minerals: Facts versus Fictions', Greenwood Pub Group Inc.

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**CLINICAL BIOCHEMISTRY- II**

**Subject Code: MMLS1-211**

**L T P C  
4 0 0 4**

**Duration: 45 Hrs.**

**UNIT-I (12 Hrs)**

**Principles and Methods for Biological Materials Estimation**

Blood serum, plasma, glucose in urine, estimation of uric acid, urea, creatinine, cholesterol; quantification of enzymes: alkaline phosphate, acid phosphate, amylase, creatine phosphokinase, Serum glutamic oxaloacetic transaminase, serum glutamic-pyruvic transaminase; estimation of Na, K, Ca, Cl, O<sub>2</sub>, CO<sub>2</sub>, P, Zn, Mg.

**UNIT-II (12 Hrs)**

**Hormones & Vitamins Estimation Methods and Their Principles**

Androgen, pregnonediol, oestrogens, corticosteroids, catecholamine, thyroid, prolactin, growth hormones: FSH, LH, testosterone; vitamins estimations: Vitamin A, thiamine, niacin, pyridoxine, ascorbic acid, vitamin D<sub>3</sub>.

**UNIT-III (11 Hrs)**

**Immunological Techniques**

RIA, ELISA, immunofixation, immunochemistry, turbidimetry and immunohistochemistry; Tumour markers.

**UNIT-IV (10 Hrs)**

**Automation in the Medical Laboratory**

Various types of autoanalyzers, reagents and kits, validation of machine, source of errors, quality assurance and quality control.

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**Recommended Books**

1. Alen H. Gowenlock, 'Varley's Practical Clinical Biochemistry', 4<sup>th</sup> Edn., CRC Publishers, 1988.
2. Ranjna Chawla, 'Practical Clinical Biochemistry Methods and Interpretation', Jaypee Brothers Medical Publishers, 2014.
3. Shruti Mohanty and Aparna B. Verma, 'Practical Clinical Biochemistry, 1<sup>st</sup> Edn., Jaypee Brothers Medical Publishers, 2003.
4. Oser Bernard L., 'Hawk's Physiological Chemistry', Tata McGrawHill, 1976.
5. David T. Plummer, 'An Introduction to Practical Biochemistry', Tata McGraw Hill, 1987.

**MOLECULAR DIAGNOSTICS**

**Subject Code: MMLS1-212**

**L T P C  
4 0 0 4**

**Duration: 45 Hrs.**

**UNIT-I (11 Hrs)**

**Introduction to Molecular Diagnostics**

Reverse transcriptase PCR, Quantitative real time PCR, the basic concept and threshold cycle, fluorescent dyes used in real time PCR, Taqman™, specimen collection and transportation, nucleic acids extraction, PCR optimization and inhibitors, handling contamination, applications of real time PCR as diagnostic tool.

**UNIT-II (8 Hrs)**

**Signal Amplification Methods**

Concept of molecular diagnostic techniques – identification, characterization and quantization of specific nucleic acids sequences, branched DNA amplification and its application in quantization of HCV and HIV, hybrid capture assay and its application in detection of HPV, invader technology.

**UNIT-III (12 Hrs)**

**Chip Based Diagnostics**

DNA sequence analysis, gene expression profiling, biomarker detection, their role in detection of diseases or their susceptibility, applications of chips, on-chip blood cells separation, on-chip extraction of cell contents such as DNA and proteins, on-chip approach for genetic analysis using miniaturized PCR, SNP detection by probe ligation and amplification (MLPA), next generation sequencing in molecular diagnostics.

**UNIT-IV (14 Hrs)**

**Molecular Diagnostics of Infectious Diseases**

Molecular diagnostics of infectious diseases such as, Leishmania, detection of large DNA viruses. Molecular diagnostics of non-infectious diseases such as cystic fibrosis, X-linked mental retardation disorder, Huntington disease, molecular markers for early detection of cancer.

**Recommended Books**

1. W.W. Grody, R.M. Nakamra, F.L. Kiechle and C. Storm, 'Molecular Diagnostics – Techniques and Applications for the Clinical Laboratory', Academic Press.

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2. L. Buckingham, 'Molecular Diagnostics – Fundamentals, Methods and Clinical Applications', FA Davis Company.

**ANALYTICAL BIOCHEMISTRY LABORATORY**

**Subject Code: MMLS1-213**

**L T P C**

**Duration: 24 Hrs.**

**0 0 2 1**

1. Preparation of Phosphate buffer and determination of pH.
2. Titration of strong and weak acids.
3. Demonstration of Osmosis and Dialysis.
4. Estimation of protein by UV Spectrophotometer by  $E_{280}/E_{260}$  method.
5. Separation of proteins by SDS gel electrophoresis.
6. Starch preparation and characterization.
7. Alpha and Beta amylolysis.

**Recommended Books**

1. K. Wilson and J. Walker, 'Practical Biochemistry: Principles and Techniques'.
2. David Plummer, 'Practical Biochemistry'.
3. S.K. Sawhney and R. Singh, 'Introductory Practical Biochemistry'.

**CLINICAL BIOCHEMISTRY- II LABORATORY**

**Subject Code: MMLS1-214**

**L T P C**

**Duration: 24 Hrs.**

**0 0 2 1**

1. Estimation of phospholipids, free fatty acids in serum.
2. Estimation, of cholesterol and triacylglycerol plasma.
3. Estimation of LDH, phosphatases, CPK in serum.
4. Thyroid function tests like T3, T4 assays.
5. Analysis of Gastric juice.
6. Chromatographic separation of sugars, amino acids, lipids and proteins.

**Recommended Books**

1. Herold Varley et al, 'Practical Clinical Biochemistry', Vol. I and II, 5<sup>th</sup> Edn., Arnold – Heinemann.
2. John Bernard Henry, 'Todd Sanford Davidson's Clinical Diagnosis and Management by Laboratory Methods', 7<sup>th</sup> Edn., W.B. Saunders Company.
3. Colowich and N.O. Kaplan, 'Methods in Enzymology', Academic Press.
4. W.J. Marshal and S.K. Angert, 'Clinical Biochemistry – Metabolic and Clinical Aspect'.