



MAHARANI LAKSHMI AMMANI COLLEGE FOR WOMEN

(NAAC ACCREDITED B++)

UGC SPONSORED CAREER OPTED COURSE

***Subject: Diploma Course in Clinical
Biochemistry***

COURSE STRUCTURE
DIPLOMA COURSE IN CLINICAL BIOCHEMISTRY

PAPER NO.	TITLE OF THE PAPER	THEORY HRS	PRACTICAL HRS	TOTAL
MODULE I	1. Developing the Clinical Biochemistry Lab 2. Blood and Hemostasis 3. Clinical Enzymes	20	20	40
MODULE II	1. Nutritional Biochemistry	35	20	55
MODULE III	1. Urine and Renal System 2. Body Fluids	15	10	25
MODULE IV	1. Hepato Reticular System 2. Biochemical Antagonists 3. Diagnostic nuclear medicine	30	10	40
TOTAL		100	60	160

**SYALLABUS FOR THE UGC SPONSORED
DIPLOMA IN CLINICAL BIOCHEMISTRY.**

1. Developing the clinical biochemistry lab.

Collection of specimens, quality control.

The normal range reference value, statistics, units, evaluation of laboratory tests.

2. Blood and Hemostasis:

Constituents of blood and their normal concentration, blood urea, creatinine, creatine and uric acid concentration.

Coagulation of blood

Prothrombin and related factors , thromboplastin, calcium, platelets, thrombin, fibrinogen, fibrin, Vit K, Heparin, fibrinolysis, The complement system
Leukocytes-phagocytosis, inflammation.

Clinical correlations:

Hemorrhagic diseases

3. Nutritional Biochemistry:

a) Fate of ingested proteins, utilization of amino acids by the body Aminoacids in the body fluids, blood and in urine.

Protein patterns in diseases, serum cellular enzyme.

Proteoglycans, fibronectin, proteins of extra cellular matrix Biochemistry of respiratory proteins, Serum mucoproteins.

Clinical Corelations:

Protein deficiency as a clinical syndrome.

Cystinuria, fanconi syndrome, Hepatocentricular degeneration.

b) Fate of ingested sugars, glucose oxidation, phosphorylation, muscle contraction,, Role of liver and hormones in the maintainence of blood glucose concentration, Diet in D.mellitus, Arterial and Venous differences in the glucose concentration, plasma insulin concentration, Glucagon, Blood lactic acid, Blood pyruvic acid, Blood ethanol.

Clinical correlations:

Clinical significance of blood glucose concentration, normal postabsorptive blood glucose concentration, glycemic level, melituria, glycosuria.

c) Fate of ingested lipids, adipose tissue, fatty acid, Ketosis, Ketone bodies in the blood and urine. Effect of meals on plasma lipids, clinical significance of plasma cholesterol concentration.

Clinical correlation:

Serum lipids in nephrotic syndrome, thyroid diseases, liver diseases, lipoidosis and xanthomatoses.

4. Urine & Renal system:

Anatomic considerations, formation of urine, glomerular filtration, reabsorption of glucose and other organic threshold substances.

Tubular secretion and excretion.

Obligatory reabsorption of water, sodium & chlorine.

Mechanism of concentration of urine.

Properties and composition of 24hrs urine sample.

Role of kidneys to control blood pressure. Renal clearances, renal calculi, endocrine functions of the kidney, renal failure.

Clinical correlations:

ADH, Diabetes insipidus, Proteinuria, Hematuria, Hemoglobinuria, Nephritis, Nephrotic syndrome, Uremia. Urinary lithiasis, renal complications in diabetes.

5. Body Fluids:

Blood volume, Edema, Lymphatic functions, Shock, Cerebrospinal fluid, Secretion of the digestive tract- saliva, gastric secretion, pancreatic secretions.

Clinical correlations:

Clinical disturbance of body fluids- Diabetic coma, gastrointestinal disturbances, Addison's disease.

6. Hepato Reticular system:

Anatomical considerations of liver, Metabolism of bilirubin, Jaundice.

Bilirubin and urobilirubin metabolism in various types of jaundice.

Liver function tests.

Bromo sulfalein excretion.

Flocculation of serum protein.

Alkaline phosphatase, cholesterol ester concentration.

Hippuric acid, serum cellular enzymes in liver disease.

Medical and surgical jaundice.

Viral hepatitis, cirrosis of the liver.

Hepatic coma.

Clinical correlations:

Grigler-Najjar syndrome.

Gilbertdisease.

Liver cirrhosis.

7. Biochemical Antagonists:

Drugs and poison

Therapeutic drug monitoring, acute poisoning & emergency methods, Drugs of abuse.

Biochemical role of a)Antiasthmatics(Theophilline)

b)Anticonvulsants

(carbonazepine,ethosuximide,primidone, phenobarbitone, phenytoin, valproate) c)Antidepressants(Dibenzazepine, opipraneol)

d)Cardioactive drugs(Digoxin, procainamide)

e)Analgesics(aspirin & other salicylates,paracetamol)

f)Barbiturates,Benzodiazepenes g)Purgatives.

8. Diagnostic nuclear medicine:

The biochemical basis of nuclear medicines.

Isotopes and radioactivity,

Ionising radiation.

Measurement of radiation.

Types of detection-

Amplifiers

Counting techniques

Invitro and invivo counting.

9. Clinical enzymes:

Reference ranges for enzymes,optimized techniques for enzyme assay.

Clinical importance of a) aminotransferase b) LDH

c)Cholinesterase d) AcetylCholinesterase e) Creatinine

phosphotransferase f) Creatine kinase, g) Creatine phosphotransferase h) Glucose-6-phosphate dehydrogenase. i) Serum alkaline phosphatase j) Serum acidphosphatase.

A general outline of the enzyme commonly involved in heart, liver, renal & bone disorders.

References:

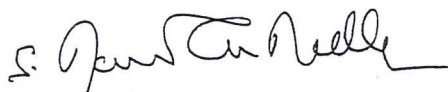
1. Varley's – Practical Clinical Biochemistry – VI Edition – Alan H Gowenlock
2. Clinical Biochemistry – Luxton & Pallister
3. The Biochemistry of Clinical medicine – W S Hoffman

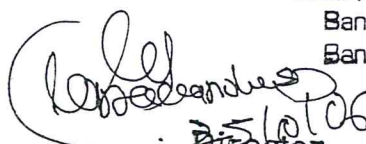
**PRACTICALS FOR DIPLOMA IN CLINICAL
BIOCHEMISTRY.**

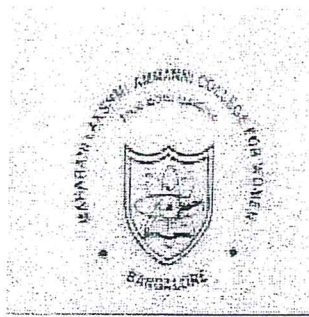
- 1) Determination of Hemoglobin in blood.
RBC count, WBC count & Hematocrit.
- 2) Renal functions tests-proteinuria, clearance test, dye tests.
- 3) Liver function tests- serum bilirubin determination, test for bile pigment in urine, bromo sulphalein test, determination of bile acids in serum, flocculation test, hippuric acid test, lab test in cirrhosis.
- 4) Measurement of total protein
Determination of protein pattern in diseases
Detection of urinary protein.
- 5) Enzyme assay determination of serum cholinesterase, acetyl choline esterase, creatine kinase, glucose-6-phosphate dehydrogenase.
- 6) Determination of serum salicylates.
- 7) Enzymatic determination of paraacetamol(KIT method).
- 8) Determination of oxalate in renal calculi.
- 9) Determination of tricyclic antidepressants by HPLC.
- 10) Test in pregnancy-PAPP test(pregnancy associated plasma proteins).

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***Subject: Certificate Course in Clinical
Biochemistry***

COURSE STRUCTURE
CERTIFICATE COURSE IN CLINICAL BIOCHEMISTRY

PAPER NO.	TITLE OF THE PAPER	THEORY HRS	PRACTICAL HRS	TOTAL
MODULE I	Clinical Biochemistry I Biomolecules, Water as Biological Solvent, Acids, Bases, pH, Buffers	20	20	40
MODULE II	Clinical Biochemistry II Chemistry of Carbohydrates, Amino acids and Proteins, Lipids, Nucleic acids	35	20	55
MODULE III	Clinical Biochemistry III Plasma Proteins, Immunoglobulins, Hemoglobin, Principles of Electrophoresis	15	20	35
MODULE IV	Clinical Biochemistry IV Vitamins, Enzymes	30	0	30
TOTAL		100	60	160

INTRODUCTION TO BIOMOLECULES

Major Elements of the Human Body,
Major Biomolecules of the Human Body,
An overview of the Major Functions and Methods used in the separation and purification of Biomolecules,
Salt Fractionation , Chromatography, Gel Filtration, Electrophoresis, Ultra Centrifugation.

WATER AS BIOLOGICAL SOLVENT

Biomedical importance, Structure of water, Dipolar Nature and Hydrogen Bonds.
Dissociation of Water.

ACIDS, BASES, pH AND BUFFERS

Modern Concepts of Acids and Bases , Weak and Strong acids, Dissociation constant, Ionic product of water pH – Henderson – Hasselbalch Equation.

Buffers – Commonly used Buffers – Bicarbonate, Citrate, Acetate, Phosphate, Tris – Hcl Buffers.

Methods used in the determination of pH, Theory of indicators use of Glass Electrodes and Reference Electodes.

CLINICAL CORELATIONS

Buffers of Blood, pH of Blood

Methods of Expressing concentrations – Percentage weight and volume, Gram molecular weight, molar solutions, Equivalent weight, Normal solutions, Calculations involved in conversions of molar solutions.

Colligative Properties: Osmolarity, Osmolality, Osmometry.

CLINICAL CORELATIONS: Basis of oral rehydration Therapy. Glucose as osmotic Diuretic in Diabetes.

CHEMISTRY OF CARBOHYDRATES

Occurance, and General Importance, Definition, Classification with Examples.

MONOSACCHARIDES: Stereo Isomerism, Optical Isomerism, Principles of Polarimetry, Reactions Characteristic of Aldehyde and Ketone groups – Oxidation, Reduction, Hydrazone Formation, Sugar Acids, Sugar Alcohols, Amino Sugars and Phosphorylated Sugars Formation of Furfurals, Methyl Glucosides, Mutarotation.

DISACCHARIDES: Structure, Properties and Biomedical Importance of Lactose, Maltose, Sucrose, Cellobiose, Isomaltose.

POLYSACCHARIDES: Homo and Heteropolysaccharides – Starch, Glycogen, Cellulose, Dextrins, Inulin Mucopolysaccharides – Heparin, Hyaluronic Acid, Chondroitin Sulphate, Dermatin Sulphate, Keratin Sulphate.

FUNCTIONS OF PROTEOGLYCANS:

CLINICAL CORRELATION:

Inulin used to Determine GFR,
Mucopolysaccharides as Components of Blood Group substances.

Clinical Significance of Mucopolysaccharides – Role in Fertilisation, Cell to Cell communication and in Tumors.

CHEMISTRY OF AMINO ACIDS:

Amino Acids in Mammalian Proteins, Properties of Amino Acids, Standard and Derived Amino Acids – Hydroxy Proline, Hydroxy Lysine, Gamma Carboxy Glutamate, Gamma Amino Butyric Acid, Beta Alanine.

CLINICAL CORRELATIONS:

Amino Acids As Neurotransmitters – Catecholamines, Glutamate.

Derivatives of Amino Acids that Serve as Hormones – Thyroid and Medullary Hormone.

Oxytocin used to Induce Labour.

CHEMISTRY OF PROTEINS:

An outline of Protein Classification, Structural Organisation – Primary, Secondary, Tertiary, Quaternary levels, Methods to study the Protein Structure, Properties of Proteins.

CLINICAL CORELATIONS:

Alterations of Primary Structure can lead to Disorders - illustration using sickle cell Anaemia.

Prion Diseases

Applied Importance of Hcl in Digestion

Precipitation of Caesin.

PLASMA PROTEINS:

Functions, Electrophoretic Separation of Plasma Protein.

CLINICAL CORELATIONS:

Alterations in Diseased Conditions – Nephrotic syndrome, Liver Cirrhosis, Viral Hepatitis, malignancy, Multiple Myeloma.

Bence - Jones Proteins.

IMMUNOGLOBULINS:

Structure, Classification and Functions of Immunoglobulins.

CLINICAL CORELATIONS:

Monoclonal and Polyclonal Gamopathy.

Use of Antibodies in Clinical Chemistry.

HAEMOGLOBULINS:

Structure of Haemoglobin, Correlations between structure and Functions.

CLINICAL CORELATIONS:

Types of Anaemias.

PRINCIPLES OF ELECTROPHORESIS

Paper, Agarose, Gel, PAGE and Immuno-electrophoresis,

CHEMISTRY OF LIPIDS:

Overview of Functions of Body Lipids,

Definition, Classification,

Fatty Acids – Saturated, Unsaturated, Physical, Chemical Properties;

Optical, geometrical Isomerism, Triglycerides, Waxes, Phospholipids

containing Glycerol, and Sphingol, Sphingomyelins, Cerebrosides and Gangliosides.

Sterols including Cholesterol

CLINICAL CORELATIONS:

Intake of PUFA Protect against Heart Attacks Prostaglandins serve as local Hormones.

CHEMISTRY OF NUCLEIC ACIDS:

Structure of Purine and Pyrimidine Bases, Nucleosides, Nucleotides, Structure of DNA, RNA, Types of RNA.

CLINICAL CORELATIONS:

Lesch – Nyhan Syndrome.

VITAMINS:

Introduction and Classification

Fat soluble vitamins

Vitamin A – Chemistry, Dietary Sources, Carotenes, Digestion, Absorbtion, Transport, Storage, Biochemical Functions, Deficiency Diseases, hypervitaminosis A, Molecular mechanism of Vision.

Vitamin D – Chemistry, Dietary Sources, Provitamin D, Digestion, Absorbtion, Transport, Storage, Biochemical Functions, Deficiency Diseases – Rickets, Osteomalacia, Calcitol Formation. Hypervitaminosis D.

Vitamin E – Chemistry, Dietary Sources, Digestion, Absorbtion, Transport, Storage, Biochemical Function, Deficiency Diseases, Antioxidant Role.

Vitamin K – Chemistry, Dietary Sources, Digestion, Absorbtion, Transport, Storage, Biochemical Functions, Deficiency Syndromes. Antagonist of Vitamin K.

Vitamin BComplex: Sources, Chemistry, Daily Requirements, Coenzyme Functions, Deficiency Symptoms of B Complex Vitamins.

Vitamin C – Sources, Chemistry, Daily Requirements, Biochemical Functions, Deficiency Symptoms.

CLINICAL CORRELATIONS:

Folate Antagonists used as Therapeutic Agents. For Combating Infections and Cancer. Wernicks Encephalopathy in Chronic Alcoholism. The Antituberculosis Drug INH Cause Deficiency of Peridoxiin.

Obstructive Jaundice can lead to Vitamin K Deficiency.

Newborn infants lack Vitamin K

Maize and Jowar Dependency could be pellagragenic.

Too much of Raw egg white consumption is injurious to health.

Achylya gastrica causes pernicious Anaemia.

Vitamin E, Selenium, Vitamin C, Synergistically to inactivate free radicals.

Vitamin D Resistant Rickets.

ENZYMES:

Introduction, Protein Nature, Ribozymes, Mechanism of Action, Concept of active Site Enzyme Specificity, Classification Based on ICMB with Typical Examples Enzyme code No. Physical Factors affecting the rate of Enzyme Catalysed Reactions – pH, Temperature, Enzyme Concentration, Substrate Concentration, K_M and its importance with Graphical Representation.

Enzyme inhibition

Reversible, Irreversible, Competitive, Non-Competitive, Un-Competitive, Illustration with graphical representation

Allosteric Enzymes

An overview of the mechanism of the regulation of enzyme activity-covalent modification, feed back inhibition.

Co-enzyme and Cofactors –concept of Holoenzymes, Proenzymes

Brief account of clinical enzymology

Clinical correlation:

Ethanol to treat, Methanol poisoning

Gout treatment by alopurinol,

use of glucose oxidase in the estimation of blood glucose

PRACTICALS

1. Preparation of standard solutions, Primary standard, Standardization of solution using indicators, Various types of titrations.
2. Determination of aminoacids concentration using formal titration.
3. Estimation of Urinary acid Ammonia and its Clinical significance
4. Free and combined acid in gastric juice and its Clinical significance
5. Qualitative test for Carbohydrates, Proteins and Lipids
Microscopis examination of osazone.
6. Precipitation reactions of Proteins, Precipitation of Caesin at its Isoelectric pH. Heat Coagulation Test, Precipitation using Acid Reagent – Trichloroacetic Acid, Perchloric Acid, Precipitation using heavy metals – lead acetate, mercuric chloride.

Scheme For identification of unknown carbohydrates Proteins.

7. Reactions of Lipids – Solubility Test, Test ofr unsaturation, Test for Cholesterol, Libermann – Burchard Test, Saponification, Apperance of Cholesterol Crystals under Microscope.
8. Principles of Chromatography,
Paper Chromatography – Separation of mixture of Amino Acids
Verification of Beer – Lambert Law.
9. Estimation of Urinary Chlorides
10. Osmotic Fragility Test

LIST OF REFERENCES

1. Harper's illustrated Biochemistry 26th edition.
2. Fundamentals of Clinical Chemistry – Tietz.
3. Practical physiological Chemistry – Harold Varley 6th edition.

COURSE STRUCTURE
CERTIFICATE COURSE IN CLINICAL BIOCHEMISTRY

PAPER NO.	TITLE OF THE PAPER	THEORY HRS	PRACTICAL HRS	TOTAL
1	Hospital practice and patient care	10		10
2	Physiology and Biochemistry - I	20	10	30
3	Biochemistry – II (Chemistry of biological compounds & their determination)	20	10	30
4	Histopathology, Hematology and clinical pathology	30	20	50
5	Enzymology, Isotopic techniques and clinical biochemistry	20	20	50
TOTAL		=	160 Hrs	

SYLLABUS

HOSPITAL PRACTICE AND PATIENTCARE

I Introduction to hospital :

Its set up and functions and the health team

Patient : As an individual, the reaction of patient and his family to illness.

- Qualities - Professional and Ethical behaviour expected
- Role and responsibilities of a lab technician in the health team

II Hospital and departmental procedures

III Communication : Interpersonal relations and communications

IV Records and reports :

V. Care of the patient

VIII First aid:

- Shock
- Hyperglycaemia, Hypoglycaemia
- Poison consumption
- Hazards in the department

Anemia: Definition, classification, major causes, Types of anemia-nutritional deficiency anaemia, Aplastic anemia, Haemolytic anemia, sickle cell Anemia, effects of anaemia on body, treatment.

Blood Indices : Color index, MCH, MCV, MCHC

CSR and PCV: Determination, definition, values, variation factors affecting, significance.

Blood Volume: Normal value, determination of blood volume and regulation of blood volume, Body fluid, pH, normal values, variation and regulation.

Lymph- Lymphoid tissue, formation, circulation, composition and functions of lymph.

Practicals:

Study of microscope and its use

_____ of blood and study of Haemocytometer

haemoglobinometry

determination of specific gravity of blood

white blood cell count

red blood cell count

determination of blood groups

Leishman's staining and differential WBC count

Determination of packed cell volume

Calculation of blood indices

FRAGILITY TEST FOR R.B.C.

Determination of bleeding time

Determination of clotting time

Blood pressure recording

Auscultation for heart sounds

Artificial respiration

Determination of vital capacity

BIOCHEMISTRY I

1. Chemistry of carbohydrates – structure classification and examples.
2. Chemistry of lipids – structure classification and examples
3. Chemistry of proteins – structure classification and examples
4. Chemistry of nucleic – structure classification and examples

(HISTOPATHOLOGY – HEMATOLOGY AND CLINICAL PATHOLOGY)

HISTOPATHOLOGY – II

1. Instrumentation:
 - a) Tissue processor, b) knife sharpener, c) automatic slide stainer, d) microtome, knife freezing microtome; cryostat, f) Instruments for crossing, g) Electric saw.
2. Frozen section techniques: CO₂ freezing, cryostat and freezing microtome.
3. Techniques and principles of sections cutting and routine staining and special stains
4. Mounting – Techniques, various mountings
5. Use of microscope, polarisers

HAEMATOLOGY

Introduction

1. Blood collection
2. Anticoagulants used in haematology
3. Normal values in haematology
4. Preparation of blood films
5. Stains used in haematology
6. Morphology of red cells
7. Morphology of leukocytes and platelets
8. Preparation of buffy coat smears
9. Laboratory methods used in the investigation of anaemias
 - a. B12 and fotate assay
 - b. Schilling test
 - c. Serum iron and iron binding capacity
10. Laboratory methods used in investigation of haemolytic anaemias
 - b. Osmotic fragility
 - c. Investigation of G-6 PD deficiency
 - d. Test for sickling
 - e. Estimation of Hb-F, Hb-A2
 - f. Plasma haemoglobin and haptoglobin, demonstration of haemosiderin in urine
 - g. Haemoglobin electrophoresis
 - h. Test for autoimmune hemolytic – anaemias
 - i. Measurements of abnormal Hb pigments

Practical:

1. Enzymes: simple enzymatic reaction, demonstration of factors affecting enzyme action, determination of A, I, K, phosphates, I, D, H, SGOT, acid phosphates, analyze – salivary and pancreatic, determination of LDH isoenzymes.
2. Liver function tests, estimation of bilirubin total and conjugated, urobilinogen, urobilin and bile acids.
3. Gastric analysis, determination of free and total acid gastric stimulation, specimen collection.
4. Accuracy, precision and quality control. Demonstration and preparation of two methods. F. test and barrettes test.
5. Collection and measurements.
6. Automation, micro and ultra micro techniques
7. Lipids determination of serum lipids, cholesterol ester, triglycerides on lipoprotein fractionation.
8. Analysis of calculi
9. Estimation of calcium, phosphorous and iron.