INTRODUCTION TO BIOCHEMISTRY

What Is Biochemistry?

The word **'BIOCHEMISTRY'**- means -**Chemistry of Living beings** or **Chemical Basis of Life.**

"Life" in Biochemistry point of view is:

- **Hundreds of Biochemical reactions** and **Biochemical processes**
- Occurring in **sub cellular organelles of a cell in an organized manner.**

- **Biochemistry is a branch of life science:**
  - Which deals with the **Study of Biochemical Reactions and Processes**
  - Occurring **in living cells of organisms.**

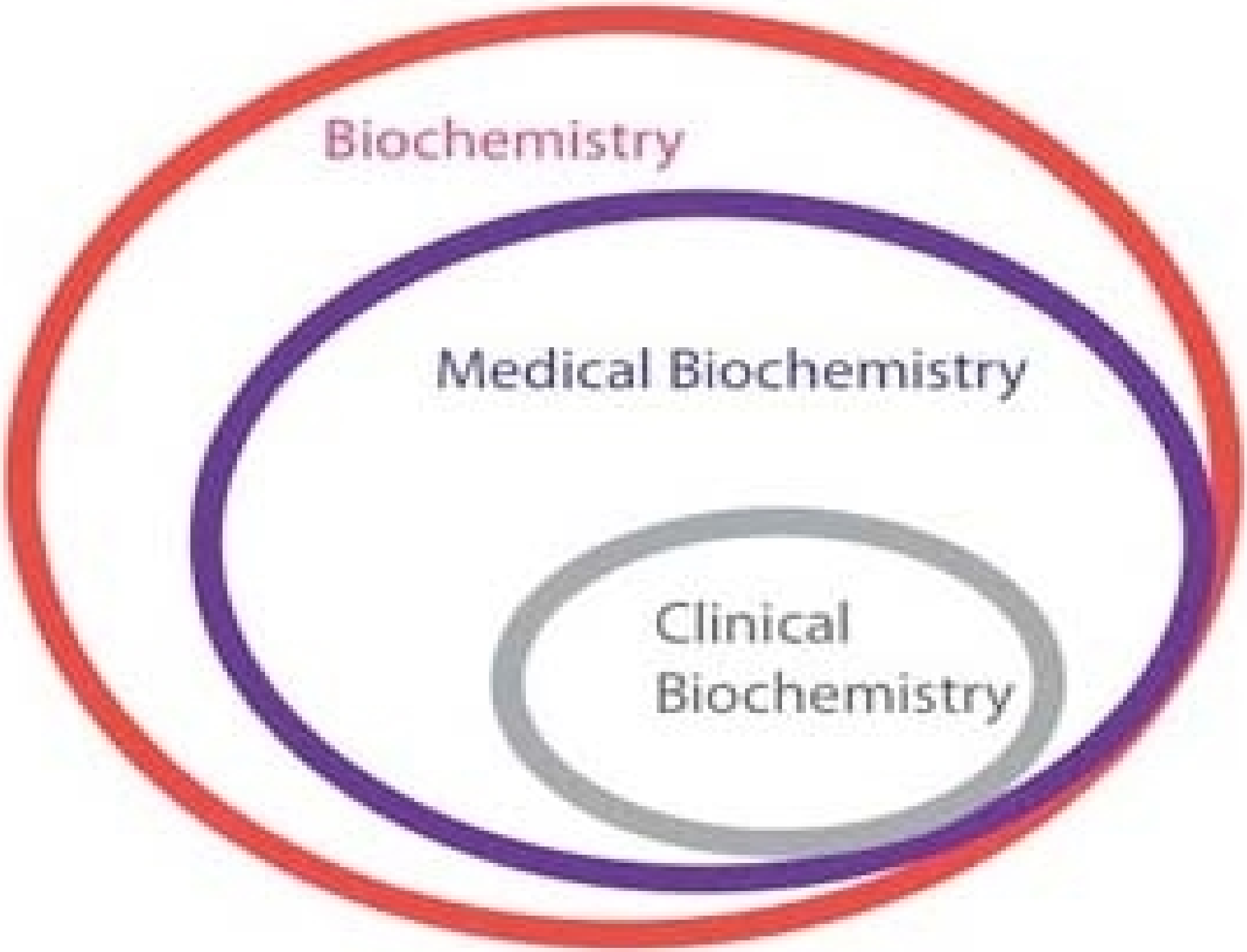
Branches of Biochemistry

- **Medical Biochemistry**-Deals with **chemical basis of human body.**

- **Clinical Biochemistry**-Deals with clinical **diseases/pathological conditions of human body.**

- **Clinical Biochemistry supports:**

- **Diagnosis, Therapy and Research** of Medical field.



- **Bacterial Biochemistry**-Deals with Microbes.
- **Plant Biochemistry**- Deals with Plants.
- **Animal Biochemistry**-Deals with animals.
- **Industrial Biochemistry**-Deals with industrial products involved with microorganisms.

Historical Developments of Biochemistry

- Biochemistry emerged in the **late 18th and early 19th century.**

- The **term Biochemistry** was first introduced by the **German Chemist Carl Neuberg in 1903.**

- In the **1940s Clinical Biochemistry evolved, as an autonomous field.**

S.No	Pioneer Workers	Discovery/Work
1	Berzilus	Enzymes Catalysis
2	Edward Buchner	Enzyme Extraction
3	Louis Pasteur	Fermentation Process
4	Lohmann	Role of Creatine PO4 in muscles
5	Hans Kreb	TCA Cycle
6	Banting and Macleod	Insulin
7	Fiske and Subbarow	Role of ATPs

S.No	Pioneer Worker	Discovery/Work
8	Watson and Crick	Double Stranded DNA
9	Landsteiner	Protein Structure
10	Peter Mitchell	Oxidative Phosphorylation
11	Nirenberg	Genetic Code on mRNA
12	Paul Berg	Recombinant DNA Technology
13	Karry Mullis	Polymerase Chain Reaction
14	Khorana	Synthesized Gene

Aim And Objectives To Study Biochemistry

- To know the various Biomolecules composed in Human body:
  - Chemistry/Structure
  - Occurrence/Location
  - Functions/Role

- **Determination of mode of action of Biomolecules** is by:
  - **Isolation and Structural elucidation** of Biomolecules.

- **Understand completely all the organized Biochemical processes**
- Occurring in **living cells at the molecular/sub cellular level .**

- **Identification of disease mechanisms:**
  - Study of **Inborn Errors of metabolism.**
  - Study of **Oncogenes in cancer cells.**

Syllabus Of Biochemistry

Medical Biochemistry

- **Medical or Human Biochemistry** is a branch of Biochemistry which deals with:
  - **Biochemical constituents of human body**
  - **Their interactions in body cells**
  - **To maintain normal health, growth and reproduction** and **related diseases.**

Chemical Composition of Human body

- **Study of Biochemical aspects of Cell and its sub cellular organelles.**

- Study of **various Biochemical constituents of cell:**

  (Chemistry, properties , functions, metabolism and related disorders).

  ① **Carbohydrates**
  ② **Lipids**
  ③ **Proteins**
  ④ **Vitamins**
  ⑤ **Minerals**
  ⑥ **Water**

Nutrition and Metabolism of Biomolecules

- **Study of Food and its constituents**
- **Dietary Nutrients builds human body and maintain health**

- Major **prerequisite for the maintenance of health** is that

- There should be **optimal dietary intake** of constituents with **good quality** and **appropriate quantity.**

- Biochemical research has impact on **Nutrition** & **Preventive Medicine.**

Metabolism of Biomolecules

- Ingestion
- Digestion
- Absorption
- Transport
- Uptake and
- Assimilation of food constituents in human body.

- **Catabolic and Anabolic pathways related to Biomolecules for Human vitality:**

- **Energy rich biomolecules** get **catabolized in body cells to liberate chemical form of energy ATP** used for various body activities.

- Various biomolecules are **biosynthesized to perform vital functions of human body.**

- To maintain **normal health of a human body:**
  - **Biomolecules in human body work**
  - **Cooperatively with good coordination ,Regulation and Interrelationship.**

Roles Of Important Biomolecules

- **Carbohydrates** serves as primary source of energy.
- **Lipids** serves as secondary source of energy.
- **Proteins** are **structural and functional units** of human body which are of prime importance and survival of human beings.

- **Vitamins:** Fat soluble and Water soluble vitamins have specific functions which serve as **accessory growth factors.**

- **Minerals:** Inorganic elements major and minor type has important role in **building and functioning of human bodies.**

- **Enzymes** are biomolecules which are **Biocatalysts catalyzes specific biochemical reactions** of metabolic pathways and considered as **functional units of metabolism**.

- **Hormones** the Endocrine substances, **chemical messengers of human body.**
- **They** bring good **coordination and regulate enzyme activities of metabolism.**

Elements of Molecular Biology

- **Nucleic acids** and Molecular Genetics
- DNA, RNA and Protein synthesis
- Regulation of gene expression
- Recombinant DNA technology

Biochemical Processes of Human Body

- Membrane **transport mechanisms and signal transduction**
  - **Biochemical mechanisms of hormone action-Cellular Homoeostasis**
  - **Functions of Neurotransmitters**
- Oxygen transport, Bioenergetics, **Mitochondrial Respiratory chain**
- The **Immune response**

Interrelationships Of Biochemistry

Biochemistry Is A Fundamental Subject Of Medicine/MBBS

- Biochemistry is related to almost every Subject of Medicine.

- There is relationship of Biochemistry with Many subjects of MBBS Course.
  - **Physiology**
  - **Pathology**
  - **Pharmacology**
  - **Immunology - Microbiology**
  - **Toxicology**
  - **Medicine and Allied Subjects**
  - **Community Medicine-Nutrition**
  - **Genetics**

Importance Of Biochemistry Knowledge To A Doctor

- **Clear understanding concepts of Biochemistry**

- Is a **prerequisite to become A Good Doctor**

- A thorough understanding **knowledge, of Biochemistry by a Doctor** helps in:

  - **Right Diagnosing and treating a patient .**

The Scope for Study and Research in Biochemistry is Endless

- **Principal driving force in Clinical Biochemistry.**

- **New emerging techniques and methodologies to study new Biomarkers**

- The **scope of Biochemistry** is to understand

- The **functionality of the living cells, tissues and the entire living system**.

Biochemistry
Teaching Schedule

- **Biochemistry Teaching Schedule-**
  - **Theory Lectures**
  - **Tutorials**
  - **Practicals**
  - **Seminar/Quiz**

Class Attendance

- **Mandatory Attendance –**
  - 75% in Theory
  - 80% in Practical
  - **Aggregate <75% -Detained**

Produce Medical Certificates

And

Apply to Sub Dean (Academics)

In absence due to illness with immediate effects.

Study Material For Biochemistry

- **Lecture Notes**
- **Books**
- **E–Books**
- **Internet websites**

Books For Biochemistry

1. Lippincott's
2. Harper
3. Vasudevan
4. U Satyanarayana
5. Rana Shinde and Chatterjea
6. S K Gupta
7. Mohammed Rafi
8. Pankaja Naik
9. Raju
10. Puri

Biochemistry Examination Pattern

Exam Pattern And Marks

Exams	Theory Marks	Practical Marks	Total Marks
Mid Semester	100	75	175
End Semester	100	75	175
Pre Prof	200 **(2 Papers)**	75	275
Prof/Final	**200 (2 Papers)**	**75**	**150**
Total Marks	**150**	**150**	**300**

MBBS First Prof Exam Dates

- **Mid Semester Examination :**

  November 2016

- **End Semester Examination :**

  January/February 2017

- **Pre Prof Exam /Preliminary Examination** : May 2017

- **Professional Exam/Final Examination**: July 2017

- One should score **50% in Theory** and **50% in Practical** Exam
- Separately to pass in the subject

- One should score 40% Marks in Internal Exams/Final Internal Assessment Marks.

- To be eligible to attend Professional Exam.

< 40% Marks

in Final Internals Detained

Tips For Success In Exams

- **Attend regularly** your teaching schedule with **full concentration** and **note the lecture points.**

- After classes **same day** **write down all lecture points in Fair note book**

- Be **Interactive and Communicative to clear your subject doubts**.

- **Analyze your own Capacity**
- **Do not compare** yourself with others.
- **Organize the schedule**
- **Truly and sincerely work hard** with **good stamina and determination.**

Daily Study the Subjects

- **Give time for each subject**
- **5 hours of study after classes**
- Give **daily one hour for Biochemistry**
- Learn to **sacrifice and compensate.**
- In between **Check your study status and compensate.**
- Relentlessly work hard to **acquire understanding knowledge.**

- **Don’t leave options** try cover all the matter thought in classes.

- **Habit of early to Bed and early to rise.**

- If **feel depress or have any problem in stay and study contact your teachers immediately for help.**

Any Queries ?

Any Confusions?

Any Doubts?

THANK YOU

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Introduction To Biochemistry Practicals

Clinical Biochemistry

Biochemical Aspects of Health and Disease

Healthy body

- **Healthy body** in biochemical point of view is with-
  - **Normal metabolic functions** in the body cells.
  - **Balanced levels** of all the **biochemical constituents**

Unhealthy/Diseased body

- **Unhealthy/Diseased body** in biochemical point of view is with:
  - **Derangement in their metabolic functions.**
  - **Imbalanced levels of biochemical constituents**

- **Health** depends on a harmonious balance of biochemical reactions occurring in the body
- **Disease** reflects abnormalities in biomolecules, biochemical reactions, or biochemical processes in a human body.

Types Of Diseases Due to Biochemical Alterations

- Nutritional Disorders
- Inborn Errors of Metabolism
- Endocrine/Metabolic Disorders
- Genetic/Molecular Disorders
- Immunological Disorders

List of Biochemical Disorders

Nutritional Disorders

- These are disorders **caused due to defect in pattern of nutrition:**
  - **Over Nutrition**
  - **Under Nutrition**

Examples Of Nutritional Disorders

- Kwashiorkar and Marasmus. (PEM)
- Obesity
- Iron Deficiency Anemia.
- Tetany
- Pellagra
- Beri Beri
- Scurvy

Endocrine/Metabolic Disorders

- These disorders are **due to defect in Endocrine system.**
- **Hypo and Hyper activity of Endocrine organs.**
- **Derangement in Hormones** which **affect the Enzyme activities of metabolic reactions .**
- This **in turn causes derangement in metabolism.**

Endocrine/Metabolic Disorders

- Diabetes Mellitus
- Diabetes Insipidus
- Hypothyroidism
- Hyperthyroidism
- Addisons Disease
- Cushings Syndrome.

Genetic/Molecular Disorders

- These disorders are **due to defect in DNA molecule.**
- **Gene mutations in structural or regulatory genes**
- Mutated genes on expression **leads to structural defective Proteins.**
- Defective structural Proteins **in turn affect the functionality of the Proteins leading to disorder.**

Genetic/Molecular Disorders

- Inborn Errors of Metabolism
- Cancer
- Sickle Cell Anemia
- Thallasemias
- Xeroderma Pigmentosa
- Hyperlipoproteinemias
- Chromosomal Defects

Inborn Errors Of Metabolism

- Disorders due to **congenital defect in Enzymes.**
- Caused **due to defective/mutated genes of Enzymes.**
- Since **Enzymes are functional units** of metabolism, **their congenital defect leads to inborn errors in Metabolism.**

Inborn Errors Of Metabolism

- Primary Gout
- Glycogen Storage Disorders
- Phenylketonuria.
- Albinism
- Gauchers Disease

Immunological Disorders

- Caused due to defective Immune System
- **Hypersensitivity**
- Auto immune Disorders- **Rheumatoid Arthritis**
- **Multiple Myelomas**

Role Of Clinical Biochemistry In Diagnosis Of Diseases

Role Of Clinical Biochemistry Laboratory

Biochemistry and Medicine are Intimately related

- In a specific diseased condition there occurs derangements in the hormonal actions
- Which affects, homeostatic mechanisms and metabolic processes
- Which in turn alters the normal concentrations of biochemical constituents in body cells and their fluids.

- Metabolic changes associated with specific disorders may give rise to a changes in the body fluids.
- **Biochemical profile of a particular body fluid is analyzed** for example
  - **Blood Glucose in Diabetes mellitus**;
  - **Glucose levels in the cerebrospinal fluid in bacterial meningitis** (which are greatly reduced).
- Hence, specific parameters are looked for in a specific body fluid when a disease is suspected

- Suspected diseased cases by a physician are investigated for the levels of biochemical parameters
- In **various collected biological specimens** viz Blood/plasma/serum/urine/CSF /other body fluids

- The collected specimens are analyzed in a Clinical Biochemistry Laboratory using **various analytical methods** to obtain the results.
- The obtained **results are compared with** the values with respective **normal/reference range.**
- Results are reported to a physician for confirming the diagnosis and treatment of the patient.

Role Of Clinical Biochemistry Laboratory

- Role of a Clinical Biochemistry Laboratory is **to find out**
- The **concentration of biochemical parameters** from **various biological specimens,**
- Using **specific methodologies ,reagents, instruments and equipments ,glasswares and plastic wares.**
- The **result values obtained are compared with reference range and interpreted**.

- Thus **Clinical Biochemistry, is an applicative arm of medical Biochemistry**,
- To **support diagnosis , treatment and prognosis of human diseases or pathological conditions**.

Scope of Clinical Biochemistry

- Clinical Biochemistry includes two main components:
  - **Methodological and Interpretative.**
- Which is driven by the **discovery of biomarkers, and the availability of appropriate measurement methods.**

Biochemistry Instruments

Biochemists should have knowledge of important instruments their uses and working principles.

1. Photoelectric Colorimeter, Spectrophotometer, Flowcytometers, AAS.

2.SemiAutoanalyzers,Fully Automated Analyzers.

3.Electrolyte Analyzers

4.ELISA reader

5.ECiQ

6.Electrophoretic and Chromatographic Units.

7. Real Time PCR

8.Distillation Plant, Balances, Centrifuges, Water baths, Incubator, Oven, Coolers, Refrigerators etc.

Biochemistry Depend Upon Chemicals and Reagents

Biochemistry Chemicals and Reagents

- Use of Analytical Grade/Ultra pure chemicals for reagent preparations.
- Use of ready made reagent kits.
- Use of standards, controls and calibrators.
- Quality control specimens (Internal and External Q.C)

Biochemistry Glasswares/Plasticwares

- Use of Borosil made Glasswares/Tarsan
- Test tubes
- Pipettes: Glass , Fine pipettes
- Flasks
- Beakers
- Measuring Cylinders
- Reagent Bottles

Diagnostic Investigations of Clinical Biochemistry

Types Of Biochemical Investigations

- Routine Investigations
- Stat Investigations-24x7 hrs
- Special Investigations
- Biochemical Profiles
- Organ Function Tests

- Individual laboratory tests are rarely ordered and reported singly; usually combinations of lab tests are used.
- The physician should however be judicious in selecting the tests that really give a clue to the diagnosis of a disease.

Routine Biochemical Investigations

- **Blood Glucose** {Fasting, Post prandial and Random}
- **Non Protein Nitrogenous Substances** -Blood **Urea ,Uric Acid, Creatinine**.(KFT)
- **Serum and urinary Proteins**-Total Proteins, Albumin (LFT)
- **Lipids**-Tri Acyl Glycerol, Cholesterol, Lipoproteins.
- **Enzymes**-AST,ALT,GGT,ALP,ACP (LFT)
- **Bilirubin**-Total ,Direct, Indirect (LFT)
- **Electrolytes**- (Na, K)
- **Minerals**-(Ca, P)
- **Blood**- pH, Anion Gap,pO2,pCO2,Bicarbonates.

Special Investigations

- Glucose Tolerance Test
- Vitamins
- Hormones
- Minerals(Mg, Zn, Cu, Fe, I)
- Drugs
- Bence Jones Proteins
- Electrophoresis
- Chromatography

Organ Function Tests

- Liver Function Tests (LFTs)
- Cardiac Profile (CFT)
- Pancreatic Function Tests (PFTs)
- Renal Function Tests/Kidney Function Tests (KFTs)
- Gastric Function Tests (GFTs)
- Thyroid Function Tests (TFTs)
- Adrenal Function Tests (AFTs)
- Reproductive Function Tests

Biochemical Test profiles And Biomarkers

- Lipid Profile
- Cardiac Profile
- Diabetic Profile
- Bone Markers
- Anemia Markers
- Tumor Markers

Importance of Laboratory Tests

- **Qualitative and Quantitative analysis** of biochemical constituents from the biological specimens are carried out in Clinical Biochemistry Laboratory.

- Results obtained of quantitative estimations are interpreated comparing with normal or reference range of laboratory.

- Biochemical Investigation results help in **diagnosis of the disorder with severity of the disease.**
- The report values helps the clinician to better manage and treat the patients under his care.

- Thus Results of Biochemica investigations plays important role in screening diagnosis, prognosis and treatment of disorders.

Precautions During Tests

- Proper Use of Reagents
- Standardization and Calibration of Instruments
- SOPs to be followed
- Carefully and Strictly follow the protocols
- Accurate pipetting
- Proper reading of O.D values/ Results
- Interpreate results with right units with normal or reference range of laboratory
- Run Quality Control Programmes

- A **good understanding Knowledge of Biochemistry related to health and disease** at molecular level
- Makes a **true and good Doctor for his/her Clinical Practice.**

Biochemistry Practical Syllabus

- Instrumentations
- Qualitative Experiment-Abnormal Urine Analysis
- Quantitative Experiments- Glucose, Urea, Bilirubin etc
- Organ Function Tests-LFT,KFT,GFT
- Biochemical Profiles
- Fluid Analysis-CSF, Amniotic Fluids
- Glucose Tolerance Test
- Clinical Cases-Liver, Carbohydrate, Lipds , Proteins
- Immunological Techniques
- Molecular Biology Techniques

Biochemistry Manual And Its Checking

Biochemistry
Practical Exam Pattern

Practical Exam 75 Marks		
Questions	**Internal Exam Pattern**	**Professional Exam Pattern**
Spott Questions	10 spots 2x10 =20 Marks	20 Marks
Qualitative Experiment	15 Marks	15 Marks
Quantitative Experiment	15 Marks	15 Marks
Grand Viva	20 Marks	20Marks
Manual	05 Marks	05 Marks

Way To Live Life

- Be Balanced in all the life activities
- Work as per your priorities
- Try to adjust as per the need and condition of life
- Try your best to survive
- Live simple and natural Life
- Know your Do’s and Don'ts of Life
- Do Right Judgements
- Work with Focus and Time Management
- Never Go Against the Nature
- Admire and Feel the Natures Life
- Think ,Thank and Praise the creator of Nature
- Imbibe Natural processes within ourselves
- Practice life like Natural processes

S. No	Human Body Activities	Human Practical Life
1	**Processes/Mechanisms**	**Actions/Character/Nature**
2	**Analyzed/Sensed** Neurotransmitters Hormones	**Analyzed/Sensed** Self Logic ,Thought process , ,Good Advice and Experience
3	**Homeostasized-** Homeostatic Mechanisms	**Regulated-** **Trust , Obedience, Respect** **Implementation**
4	**Balanced Processes**	**Limited Activities**
5	**Healthy Human Life**	**Success in Human Life**

Thank You