Clinical Biochemistry (Theory)

Total: 8hours /week
Lecture: 4 hours/week
Tutorial: 0 hour/week
Practical: 4 hours/week
Lab: 0 hours/week

Course Description

The course is designed to provide basic but comprehensive knowledge of basic chemistry and biochemistry, which has direct application in clinical biochemistry. This course consists of relevant chapters from pure sciences (recall), which has got direct application on this subject. Clinical biochemistry includes the biochemical processes of - digestion & absorption of foods, metabolism of different kinds of foods & their disturbance effects in our body together with the physiological roles of different kinds of vitamins & enzymes. It also provides good theoretical background in the field with the practical experience hand in hand. This will be tested in practical & theory during the process of teaching. Each student will have to work in close association with each other. This course is based more on practical work.

Course Objectives

After completing this course, the student will be able to.

- Familiarize with elementary and physical chemistry.
- Describe the biochemical processes of different kinds of foods in our body.
- Identify the role of vitamins & enzymes in our body.
- Make biochemical estimation.
- Handle different equipment for biochemical analysis.
- Prepare chemical reagents for biochemistry laboratory.

Course Content

Unit 1: Introduction to Biochemistry **2 hrs**

- Definition
- Scope, fields and importance of biochemistry
- History of biochemistry

Unit 2: Elementary chemistry **12 hrs**

- Definition of atom, molecule, atomic number, atomic weight, molecular weight, equivalent weight, specific gravity and chemical equation (oxidation and reduction).
- Solution
    - Solution, types of solutions: saturated, unsaturated, supersaturated, normal, molar, molal and percentage solutions.
    - Preparation of different concentration of normal, molar, and percentage solutions.
    - Buffer and standard solutions.
    - Osmosis and diffusion.

Unit 3: Physical chemistry **15hrs**

- Principle, functions, handling and maintenance of:
  - Water bath
  - Centrifuge
  - Analytical balances
  - Colorimeters
  - Spectrophotometers
  - Micro-pipettes
- Glasswares (Composition and use) and their cleaning.
- Changes occurring in the blood after collection
- Laboratory hazards and precautions to be taken while working in the clinical chemistry laboratory.

Unit 4: Biomolecules and Metabolisms

Bio-molecules **40 hrs**

- Introduction, Types and importance of Biomolecules
- Carbohydrate:
  - Introduction, Definition, Functions.
  - Classifications of Carbohydrates in detail.
  - Monosaccharides: Types with it's examples and its importance, Physical and Chemical Properties.
  - Disaccharides: Definition,importance and Types(Sucrose, Maltose & Lactose).
  - Oligosaccharides: Definition with examples
  - Polysaccharides: Definition, importance and Types (Homo & Hetero-polysaccharides)

- Proteins:
  - Introduction, Definition and Functions of Proteins.
  - Amino Acids: Introduction and properties
    - Classifications of amino acids: based on the structure, nutritional requirement and metabolic fate.
  - Classifications of Proteins:
    - Functional classification
    - Classification based on chemical nature and solubility and
    - Nutritional classification
  - Properties of Proteins
  - Structures of Proteins
  - Denaturation: Definition, Agents and characteristics of denaturation.
  - Coagulation and Flocculation of protein

- Lipids:
  - Introduction, Definition, Functions and Classifications of Lipids.
  - Triglycerides: Introduction and properties (Hydrolysis, Saponification, Rancidity and Lipid Peroxidation).
  - Fatty Acids: Definition and classification (Saturated & unsaturated)
  - Essential fatty acids: Definition, functions, examples and deficiency manifestation.

- Phospholipids: Introduction, types and functions.
- Cholesterol: Introduction, properties and functions.

- Plasma Proteins:
  - Introduction and types.
  - Enumerate the functions with normal range of different plasma proteins.
  - Abnormalities of Plasma Proteins.
  - Electrophoretic pattern of plasma proteins in normal and abnormal conditions.

- Enzymes:
  - Introduction, Definition and Classification of Enzymes.
  - Factors affecting enzyme activity in detail.
  - Salient features of active site.
  - Enzyme Inhibition in brief.
  - Mechanism of Enzyme Action
  - Units and It's applications
  - Coenzymes: Introduction, definition & function with examples.
  - Isoenzymes: Introduction, definition and it's features. Isoenzymes of LDH, CPK & ALP
  - Diagnostic Importance of Enzymes and their pattern in diseases.

- Vitamins:
  - Define vitamins
  - Classify vitamins − fat-soluble and water-soluble.
  - List dietary sources and RDA of each of the vitamins.
  - Describe physiological roles of all vitamins.
  - Deficiency manifestations of each vitamins.

- Minerals:
  - Introduction & Classification.
  - Biochemical functions and deficiency manifestations of Iron, Calcium, Phosphorus, Sodium, Potassium and Iodine.

- Hormones:Introduction, definition, functions and classifications.

- Tumor Markers: Introduction, Classification & their significance.
- Basic concept of nucleic acid.
  - Define nucleoside,nucleotide and nucleic acid.
  - Differentiate between DNA/RNA.

Unit 5: Metabolism of Biomolecules **35hrs**

- Introduction to Metabolism
- Metabolism of Carbohydrates:

- Major pathways of carbohydrate metabolism and Entry of glucose into the cells.
- Glycolysis: Introduction, Salient features, pathway, Energetics, Regulation and Clinical Significance..
- Clinical Significance.
- Gluconeogenesis: Introduction, Importance & Pathway
- Brief introduction to Cori's Cycle, Rapaport Luebering Cycle, HMP shunt pathway, Glycogen Metabolism and their significance.
- Regulation of Blood Glucose Level inside the body including hormonal regulation.
- Diabetes Mellitus: Introduction, Types, Cardinal symptoms, Complications, Lab. Diagnosis and Management.
- Glucose Tolerance Test: Patient preparation, Procedure and Interpretation.
- Introduction to Glucose Challenge test.
- Enlist inborn errors of carbohydrate metabolism.

- Metabolism of Proteins:
  - Introduction, Amino Acid Pool, Overview of amino acid metabolism.
  - Protein Catabolism
    - Transamination: Introduction, salient features & mechanism.
    - Deamination: Oxidative & Non-oxidative
    - Urea Cycle: Introduction, pathway, energetics, Regulation and clinical significance of blood urea.Blood Urea Nitrogen(BUN).
  - Non Protein Nitrogenous substances (Creatine, Creatinine, Uric Acid, Bilirubin)
  - Enlist inborn errors of protein metabolism.

- Metabolism of Lipids:
  - Introduction to Fatty acid oxidation and its various pathways.
  - β-oxidation of fatty acids: Introduction , pathway, Energetics, regulation and clinical significance
  - Ketone bodies: Introduction, Ketogenesis(synthesis), Ketolysis(utilization) & clinical significance.
  - Fatty Liver and associated health risks.
  - Enlist inborn errors of lipid metabolism.

Unit 6: **Estimations of different biochemical analytes** **30 hrs**

- Various methods, Principle, Procedure, Reference Range, Clinical significance, precautions in the estimation of:
  - Sugar
  - Urea
  - Creatinine
  - Uric Acid
  - Serum Bilirubin(Total & Direct)
  - Total Protein
  - Albumin

- A/G Ratio
- SGPT/ALT
- SGOT/ AST
- Alkaline phosphatase (ALP)
- Lipid Profile Tests : (Triglycerides, Total Cholesterol, HDL, LDL, VLDL)
- Amylase
- Serum Calcium and Phosphorous
- Serum Electrolytes (Na , K)

- Organ Function Tests: Introduction and interpretation of
  - Liver Function Tests (LFT)
  - Renal Function Tests (RFT)
  - Pancreatic Function Tests (PFT)
  - Cardiac Function Tests (CFT)
  - Thyroid Function Tests (TFT)

Unit 7: Quality control in clinical chemistry laboratory **6 hrs**

- Effects of time, pH, temperature and light on chemical reagents.
- Preservation of chemicals used in biochemistry laboratory.
- Quality Control(QC) in biochemistry laboratory

Reference books

- Clinical Biochemistry- Tapeshwar Yadav, Highland Publication, Pvt. Ltd., Bhotahity, Kathmandu
- Biochemistry U. Satyanarayan.
- Fundamental Biochemistry -A.C.Dev
- Varley´s Practical Clinical Biochemistry Goweklook.
- Quality control in clinical laboratory David Tonks
- An introduction to medical laboratory technology F J Baker, R E Silverto
- An introduction to Medical Technology F J Baker
- Harper´s Biochemistry Harper
- A Text Book of Clinical Chemistry Teitz
- A biologist guide to principles and techniques of practical biochemistry Bryn & Keith
- A Text Book of Clinical Biochemistry S. Baral, N. Parajuli, P. Hamal & K. Poudel

Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
Unit Hours	2	12	15	40	35	30	6	140
Marks	1	7	9	23	20	17	3	80

Clinical Biochemistry (Practical)

Hours140:

Perform the following tasks:

- Prepare normal and percentage solution of NaCl.
- Perform separation of Serum and Plasma.
- Perform blood glucose by GOD-POD method.
- Perform blood urea by Berthelot method.
- Prepare calibration curve for blood glucose and blood urea estimation.
- Perform serum creatinine by Alkaline picrate method.
- Demonstrate clearance tests (Urea and Creatinine)
- Perform serum uric acid by enzymatic method.
- Perform serum total protein by Biuret method.
- Perform serum albumin by Bromocresol Green method.
- Perform bilirubin by modified Jendrassik&Grof method.
- Perform serum Total cholesterol by CHOD-PAP method.
- Perform serum Triglyceride by GPO-PAP method.
- Perform HDL-Cholesterol by PEG/CHOD/PAP method.
- Perform serum SGPT by UV-kinetic method.
- Perform serum SGOT by UV-kinetic method.
- Perform serum alkaline phosphatase (ALP).
- Perform serum amylase.
- Perform serum calcium O-Cresolphathaleincomplexon (OCPC) method.
- Perform serum inorganic phosphorus by Gommorris method.
- Perform serum sodium/potassium by ISE.
- Demonstrate estimation of Total Creatine Phosphokinase (CPK).
- Demonstrate estimation of Glycated haemoglobin (HbA_1c).