AS PER PCI REGULATIONS
FIRST YEAR B. PHARM | SEMESTER-II

BIOCHEMISTRY

Dr. KUNTAL DAS

NIRALI PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

A Text Book of

BIOCHEMISTRY

As Per PCI Regulations

FIRST YEAR B. PHARM.

Semester - II

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Dedication …

Dedicated to

Parents, Wife and Son

Preface

This is the first edition and first time the attempt has been made to write a biochemistry text book as per the new syllabus prescribed by Pharmacy Council of India for Semester-II. There are many text books on Biochemistry already available in market by famous authors. Most of the information in this book has presented in a very simple manner, with more tables, figures and wherever necessary with diagrams. The aim of this book is to make the subject easy and understandable to the student. This book is as per the revised syllabus prescribed by the Pharmacy Council of India under Regulations 6, 7 and 8 of the Bachelor of Pharmacy (B. Pharm.) course regulations 2014 in 2016 and amended from 2017 onwards throughout India under same uniform syllabus. As per the norms, the book is compiled with semester wise syllabus in which Biochemistry is under Semester-II.

Semester-II, Biochemistry subject is divided into five sub-units.

Unit I, this sub-topic has discussed with biomolecules and bioenergetics. Detailed study on carbohydrate, lipids, nucleic acids, amino acids and proteins is given along with generation of free energy, energy rich compounds.

Unit II, deals with carbohydrate metabolism and biological oxidation. In carbohydrate metabolism, the sub-topic deals with how carbohydrate metabolite synthesize, their utility in human body and excreted products from the body. It describe various metabolic cycles and various hormonal activities through which physiological functions are carried out. The most important cellular respiration mechanism is also described in this unit.

Unit III, discuss about the lipid and amino acid metabolism. In lipid metabolism, most important β-oxidation mechanism, fatty acid synthesis, role of lipids in body, biological significance of cholesterol and various metabolic disorders are discussed. In the very next part, various methods for amino acid metabolism, their disorders, synthesis of various hormones are discussed.

Unit IV: discuss about the genetical materials, nucleic acid metabolism, genetical units like DNA, RNA, their structure, formation etc. In this part various methods of protein synthesis, role of inhibitors are also described.

Unit V: discuss detail enzyme study. Definition, classifications, kinetics, inhibitors, coenzymes and their therapeutic and industrial uses are revealed elaborately.

It is hoped that all the units will provide up to date knowledge to all the students with the detail information by systemic manners described in this book.

I am forced to publish this first edition of my book with better hope to gain the popularity by the students and readers throughout the country. Any criticism and suggestions from the readers are always welcome. In the future editions, such suggestions will be incorporated and other mistakes will be rectified.

It is my great privilege to acknowledge the help from all the published books and websites from the internet for completing this book. My sincere and heartiest gramercy to Dr. Raman Dang (ex. principal of Krupanidhi College of Pharmacy, Bangalore), presently Registrar of DPSRU New Delhi, for his valuable suggestions and positive motivation. My sincere thanks and respect to chairman sir, Prof. Suresh Nagpal, vice chairperson madam, directors present principal Dr. Amit Kumar Das, all teaching, non-teaching staff of my college for their active co-operation and encouragement. My special thanks to my colleague Mrs. Prabitha Prabakaran for her sincere advice for writing this book.

I felt no word to express sense of indebtedness to my parents, Mrs. Kalyani Das and Dr. Dilip Kumar Das (Emeritus Fellow UGC), whose silent blessings, and encouragement, help me to put my best foot forward in all my endeavors of chasing my dreams in life.

My special and sincere thanks to my wife Mrs. Sangita Das and son Master Niladri Das for their inspiration to pursue the work in all the situations.

Lastly but not the least, I thankful to Mr. Malik Shaikh, Mrs. Manasi Pingle, Ms. Shilpa Zade and Shri. Jignesh Furia, M/S Nirali Prakashan for his kind publication of the book with much care.

Prof. Kuntal Das

M. Pharm, Ph.D

Syllabus

Unit I **08 Hours**

Biomolecules

Introduction, Classification, Chemical nature and Biological role of carbohydrate, Lipids, Nucleic acids, Amino acids and Proteins.

Bioenergetics

Concept of free energy, Endergonic and exergonic reaction, Relationship between free energy, Enthalpy and entropy; Redox potential.

Energy rich compounds; Classification; Biological significances of ATP and Cyclic AMP

Unit II **10 Hours**

Carbohydrate Metabolism

Glycolysis - Pathway, Energetics and significance.

Citric acid cycle - Pathway, Energetics and Significance.

HMP shunt and its significance; Glucose-6-Phosphate Dehydrogenase (G6PD) deficiency.

Glycogen metabolism pathways and Glycogen storage diseases (GSD)

Gluconeogenesis – Pathway and its significance.

Hormonal regulation of blood glucose level and Diabetes mellitus.

Biological Oxidation

Electron transport chain (ETC) and its mechanism.

Oxidative phosphorylation and its mechanism and substrate level phosphorylation.

Inhibitors ETC and Oxidative phosphorylation/Uncouplers.

Unit III **10 Hours**

Lipid Metabolism

β-oxidation of saturated fatty acid (Palmitic acid).

Formation and utilization of ketone bodies; ketoacidosis.

De novo synthesis of fatty acids (Palmitic acid).

Biological significance of cholesterol and Conversion of cholesterol into bile acids, Steroid hormone and vitamin D.

Disorders of lipid metabolism: Hypercholesterolemia, Atherosclerosis, Fatty liver and Obesity.

Amino Acid Metabolism

General reactions of amino acid metabolism: Transamination, Deamination and Decarboxylation, Urea cycle and its disorders.

Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, Alkeptonuria, Tyrosinemia).

Synthesis and significance of biological substances; 5-HT, Melatonin, Dopamine, Noradrenaline, Adrenaline.

Catabolism of heme; Hyperbilirubinemia and Jaundice.

Unit IV 10 Hours

Nucleic Acid Metabolism and Genetic Information Transfer

Biosynthesis of purine and pyrimidine nucleotides.

Catabolism of purine nucleotides and Hyperuricemia and Gout disease.

Organization of mammalian genome.

Structure of DNA and RNA and their functions.

DNA replication (semi conservative model)

Transcription or RNA synthesis.

Genetic code, Translation or Protein synthesis and inhibitors.

Unit V 07 Hours

Enzymes

Introduction, properties, nomenclature and IUB classification of enzymes.

Enzyme kinetics (Michaelis plot, Line Weaver Burke plot).

Enzyme inhibitors with examples.

Regulation of enzymes: Enzyme induction and Repression, Allosteric enzymes regulation.

Therapeutic and diagnostic applications of enzymes and isoenzymes.

Coenzymes – Structure and biochemical functions.

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Contents

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Unit ... 1

BIOMOLECULES AND BIOENERGETICS

♦ LEARNING OBJECTIVES ♦

- To know about general description of biomolecules, their classification, chemical nature.
- To know about the role of carbohydrate, lipid, nucleic acids, amino acids, proteins
- To know about detail study of bioenergetics with respect to free energy, their reactions.
- To know about the relationship between free energy, enthalpy and entropy.
- To know about detailed study on redox potential.
- To know about energy rich compounds and their classification
- To know about biological significances of ATP and cyclic AMP

BIOMOLECULES

1.1 INTRODUCTION

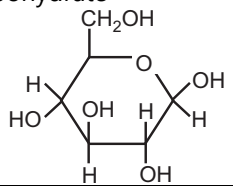
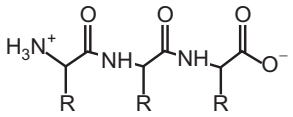
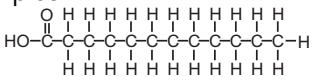
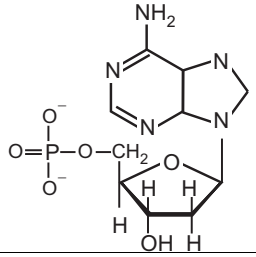
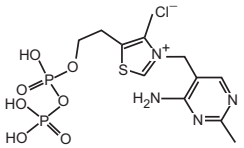
The cells are the fundamental units of life. They are the store house of various molecules which are responsible for bio-action. Biomolecules are molecules occurring in living organisms. They are used for the maintenance and metabolic processes of living organisms. They are macromolecules or poly anions like proteins, carbohydrates, lipids and nucleic acids and include small molecules like primary and secondary metabolites and natural products (Table 1.1). Generally they consist of elements like carbon, hydrogen, nitrogen, oxygen, sulphur and phosphorus. They are very large molecules of many atoms which are covalently bound together. These elements constitute about 90% of the dry weight of the human body. Biomolecules are usually endogenous but sometimes exogenous substances like pharmaceutical drugs originate from natural or synthetic sources.

Some of the important biomolecules are water, amino acids, carbohydrates, proteins, lipids, nucleic acids, enzymes etc (Table 1.2). Human body is composed of 60% water, 15% proteins and lipids each, 2% carbohydrates and 8% minerals.

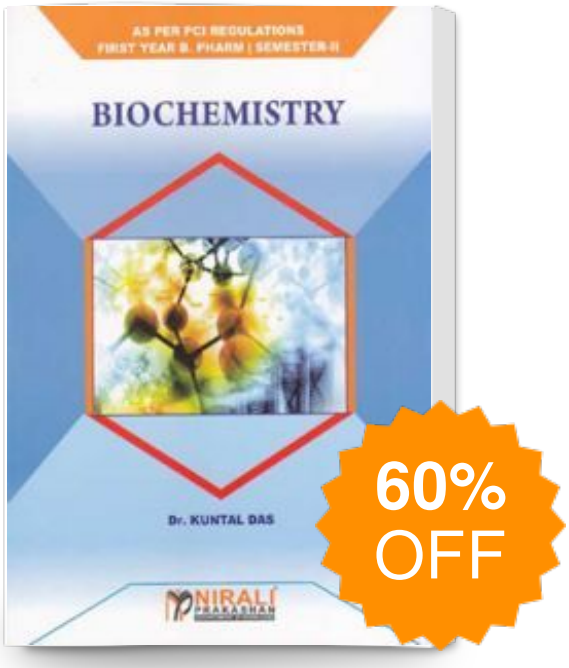
Table 1.1: Important biomolecules

Small Molecules	Derived Macromolecules	Atomic Constituents
Amino acids	Proteins	C, H, O, N (S)
Sugars	Starch	C, H, O
Fatty acids	Fats, oils	C, H, O
Purine and Pyrimidine	Nucleic acids	C, H, O, N
Nucleotide	DNA and RNA	C, H, O, N, P

Table 1.2: Different biomolecules with their functions

Biomolecules	Monomers	Example	Functions
Carbohydrate 	Monosaccharides	Glucose Fructose Lactose Cellulose	They provide energy to the cells and also provide the materials for constitution of cell membrane.
Proteins 	Amino acids	Hemoglobin Insulin, enzymes, Antibodies	They provide structure of the body, provide energy, improve rate of reaction and immunity.
Lipids 	Glycerol and fatty acids	Fats, oils, waxes	They store energy, act as insulator and protector.
Nucleic acids 	Nucleotides	DNA, RNA	It contains genetic information, directs growth and development.
Enzymes 	Amino acids	Citric acid synthetase, topoisomerase, Estrases, Fumarase	They act as biocatalyst and reduce reaction, unaffected by any reaction, reusable.

Biochemistry



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