

# BIOCHEMISTRY AND CLINICAL PATHOLOGY

First Year Diploma in Pharmacy

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TEXT BOOK OF

# **BIOCHEMISTRY AND CLINICAL PATHOLOGY**

FIRST YEAR DIPLOMA IN PHARMACY  
(AS PER E. R. 1991)

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Price ₹ 70.00



**N1234**

**BIOCHEMISTRY AND CLINICAL PATHOLOGY ISBN 978-81-85790-16-9****Thirty-Fourth Edition : July 2018**© : **Authors**

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**Published By : (-ve)**  
**NIRALI PRAKASHAN**Abhyudaya Pragati, 1312, Shivaji Nagar,  
Off J.M. Road, PUNE – 411005  
Tel - (020) 25512336/37/39, Fax - (020) 25511379  
Email : niralipune@pragationline.com**Printed By :**  
**RACHANA OFFSETS**S. No. 15, Arihant Marg  
Sukhsagar Nagar, Katraj  
PUNE - 411 046  
Tel - (020) 26963220**DISTRIBUTION CENTRES****PUNE****Nirali Prakashan :** 119, Budhwar Peth, Jogeshwari Mandir Lane, Pune 411002,  
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## **PREFACE TO THIRTY-FOURTH EDITION**

It is our pleasure to release the thoroughly revised Thirty-fourth Edition of this text within very short period.

As suggested by few colleagues, we have added glossary and Normal Laboratory Values for ready reference. We hope the readers will find them in order.

Really we are deeply indebted to them, without their help and encouragement complete revision would have been impossible.

We are sure, we shall keep receiving the same co-operation in future as received in the past.

**July 2018**

**Authors**

## **PREFACE TO THE FIRST EDITION**

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It gives us great pleasure in presenting this package to the students of First Year Diploma in Pharmacy as per E. R. 1991.

Taking into consideration the importance and need of the knowledge of 'Biochemistry' for a student pharmacist alongwith the information on all other pharmaceutical subjects, Pharmacy Council of India has introduced this subject for the first time, in the last three decades.

Though large number of books are available in the market covering the subject to a great extent, we have made an attempt to meet the 'Specific requirements' of the students of Diploma in Pharmacy in simple and lucid language.

We hope this book will prove its beneficial utility for the students and the teachers.

All sort of suggestions and criticisms for the improvement of the contents of this text will be highly appreciated.

We are highly thankful to Shri. Dineshbhai Furia of Nirali Prakashan and his staff for bringing this publication timely to the market.

**7<sup>th</sup> June 1993**  
**Sankashti Chaturthi**

**M. R. Chaudhari**  
**S. B. Gokhale**

## SYLLABUS

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**Theory hours : 50**

**Marks – 100**

1. Introduction to Biochemistry
2. Brief chemistry and role of **proteins**, polypeptides and amino **acids**, classification, qualitative tests, biological value.  
Deficiency diseases.
3. Brief chemistry and role of **carbohydrates**, classification, qualitative tests. Diseases related to carbohydrate metabolism.
4. Brief chemistry and role of **lipids**, classification, qualitative tests. Diseases related to lipid metabolism.
5. Brief chemistry and role of **vitamins** and coenzymes.
6. Role of **minerals** and water in life processes.
7. Enzymes : Brief concept of enzymic action factors affecting it. Therapeutic and pharmaceutical importance.
8. Brief concept of normal and abnormal metabolism of proteins, carbohydrates and lipids.
9. Introduction to pathology of blood and urine.
  - (a) Erythrocytes-Abnormal cells and their significance.
  - (b) Lymphocytes and platelets, their role in health and diseases.
  - (c) Abnormal constituents of urine and their significance in diseases.

### **Biochemistry and Clinical Pathology - Practicals**

**Hours : 75**

**Marks - 100**

1. Detection and identification of Proteins, Amino acids, Carbohydrates and Lipids.
2. Analysis of normal and abnormal constituents of Blood and Urine (Glucose, Urea, Creatine, Creatinine, Cholesterol, Alkaline phosphatase, Acid phosphatase, Bilirubin, SGPT, SGOT, Calcium, Diastase, and Lipase).
3. Examination of sputum and faeces (microscopic and staining).
4. Practice in injecting drugs by intramuscular, subcutaneous and intravenous routes. Withdrawal of blood samples.

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## SALIENT FEATURES OF THE TEXT

**Total Number of Pages : 165**

**Total Number of Figures : 050**

**Total Number of Tables : 21**

- \* Definitions of all important biochemical terms (Glossary).
- \* Every chapter followed by important questions.
- \* Provided with normal physiological parameters.
- \* Introduction to every chapter with its importance in biochemical studies.
- \* Systematic classification of Dietary nutrients  
i.e. Carbohydrates, proteins and lipids.
- \* Biochemical importance of nutrients.
- \* Qualitative tests for proteins, lipids and carbohydrates.
- \* Therapeutic and pharmaceutical importance of enzymes.
- \* Importance of minerals in life-processes.
- \* Brief account of pathology of blood and urine.



# INTRODUCTION TO BIOCHEMISTRY

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## INTRODUCTION

To understand the functioning of organism properly one has to study and understand the chemical changes occurring in cell or biological system all the while. **However, the study dealing with the chemistry of living system is known as Biochemistry.** The term Biochemistry has been introduced by a well-known German chemist Carl Newberg in 1903. The knowledge of Biochemistry has been compiled through experimentation, it has a past, a present and future. It is a scientific approach for the construction of physico-chemical knowledge and understanding of living systems, thus it is a basis of all biological sciences.

This book deals with nature and working of the biomolecules such as proteins, carbohydrates, fats etc. Most of the metabolic pathways are common in all biological systems. The minor differences in the metabolism of prokaryotic cell and eukaryotic cell are very well exploited for the drugs against pathogens. Even abnormalities of metabolism are corrected by dietary modifications. There are examples in which the **knowledge of Biochemistry is used to control diseases, abnormal metabolism and the treatment of deficiencies.**

The biochemical processes in cell occur not only in free solution but are related with macromolecular structures. Biochemistry deals with the structure of tissues, cells, organelles and individual molecules themselves. Now-a-days biochemistry has become the language of medicine, **its principle and experimental methods underpin all the basis of drug action, drug synthesis and prevention of diseases.** The boundaries between biochemistry and applied sciences such as pharmaceutical sciences, medicine, agricultural sciences have become blurred.

(1.1)

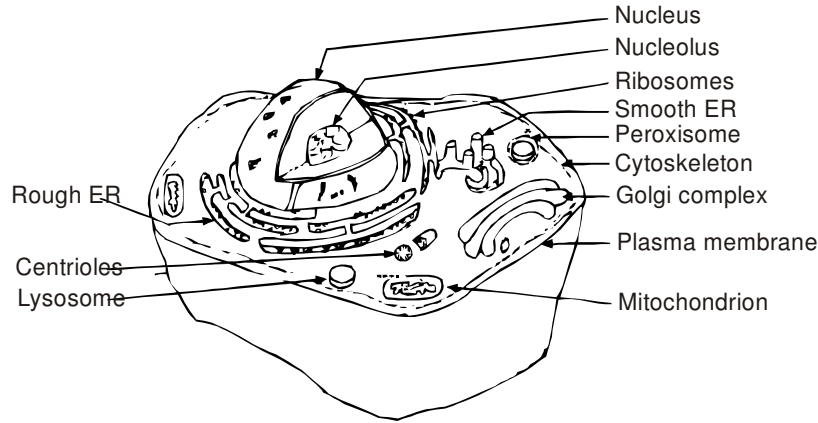
## THE CELL

With the discovery of the microscope, fundamental unit of biological system was recognised i.e. cell. Functioning of cell and the co-ordination of all biochemical processes were studied with the help of modern techniques such as electron microscope, ultracentrifuge and number of biophysical methods. Typical structure of cell is output of all these efforts. Fig. 1. 1 is the most generalised picture of the cell. It is not simply a collection of organelles, but it illustrates functioning of cell and metabolic co-ordination between cell organelles.

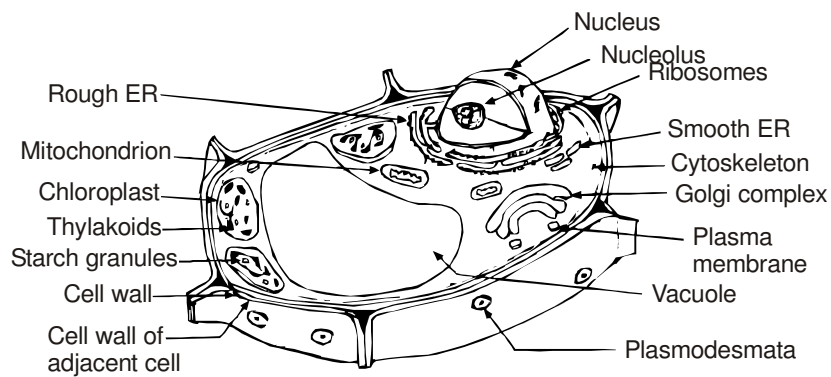
Before knowing the structure and functions of various cell organelles one must know the structural difference between a plant cell and an animal cell.

**Table 1.1 : Difference between plant and animal cell**

<b>Animal Cell</b>	<b>Plant Cell</b>
1. Cell wall is absent.	1. Cell wall is present.
2. Plasma-membrane is the outermost boundary of the cell.	2. Cell wall is the outermost boundary of cell.
3. Plastids are absent.	3. Plastids are present.
4. Lysosomes are present.	4. Lysosomes usually absent.
5. Pair of centrioles is present.	5. Centrioles are absent.
6. Vacuoles are absent, if observed are many and small.	6. Large central vacuole is present.
7. Phagocytosis or Pinocytosis is observed.	7. Phagocytosis or Pinocytosis is not observed.
8. Golgi apparatus is present with specific polarity.	8. Golgi apparatus is scattered in the cytoplasm.



**Fig. 1.1 : Animal cell**



**Fig. 1.2 : Plant cell**

The structure and functions of each cell-organelles in short are as under.

**Plasma-membrane (Plasmolemma) :**

A typical animal cell is bounded by a thin membrane known as plasma-membrane or cell membrane, which is of 75 Å thickness. Plasma membrane is made up of thick layers.

The outer layer is made up of proteins and polysaccharides; the middle layer consists of phospholipids and cholesterol level, while the inner layer contains only proteins.

Nature of lypo-proteins of cell membrane decides the change in membrane and the movement of molecules across the membrane. It is semi-permeable and encloses the cytoplasm in which various and very important organelles are present.

#### **Nucleus and Nucleolus :**

A dense spherical structure called **nucleus** is present in the centre of the cell. It has a double layered nuclear membrane called nuclear envelope. The nucleolus is composed of two important nucleic acids, the deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). RNA is in granular form and DNA is in chromosome form.

Within the nucleus, a single or more spherical bodies called nucleoli are present. The nucleolus is the aggregation of portions of chromosomes which are responsible for the secretion of the ribosomes, the sub-units. Inside the nuclear membrane the living matter is called nucleoplasm. The double layered nuclear membrane is porous and provides a continuity between cytoplasm and the contents of the nucleus (chromosomes).

The outer nuclear membrane bears ribosomes which may continue with the membrane of endoplasmic reticulum.

#### **Mitochondria :**

Within the cytoplasm, there are numerous double layered elongated bodies called mitochondria. It is composed largely of proteins and lipids. These are responsible for transference of chemical energy into biological energy in the form of ATP compounds. All enzymes involved in Kreb's cycle are present in mitochondria. It is also responsible for transmission of hereditary characters. Each mitochondria is composed of tubular or paired lamellae called cristae. It is the site for carbohydrates and lipid (fat) metabolism, i.e. respiration.

#### **Golgi Apparatus :**

The golgi apparatus (body) is compact and consists of parallel membrane plates and tubules. It is the site for enzyme secretion. It participates in the formation of lysosomes.

#### **Endoplasmic Reticulum and Ribosomes :**

Within the cytoplasm of the cell is an extensive network of membrane arranged in plates and tubules, collectively known as the

endoplasmic reticulum. It is the site for biochemical synthesis and intracellular transport of molecules.

The endoplasmic reticulum present is attached to the nuclear membrane of the plasma-membrane. On the membrane of endoplasmic reticulum, there are small round bodies present called ribosomes. It is the site for protein synthesis. The endoplasmic reticulum with the ribosomes is called the rough endoplasmic reticulum, while the other devoid of ribosomes it is called the smooth endoplasmic reticulum.

**Lysosomes :**

The lysosomes are small vesicular structures containing homogeneous fluid. It is composed of a single layer and contains digestive enzymes for intracellular digestion.

**Microtubules :**

These are tubular structures composed of globular protein and held in intracellular transport.

**Microfilaments :**

These are protein filaments in the cytoplasm meant for contraction and mobility of the cell.

The animal cell is responsible to perform functions like motility, digestion, metabolism, growth, reproduction and irritability.

**HYDROTROPY AND HYDROTROPIC SUBSTANCES :**

Substances having the power of making water-insoluble substances water-soluble are called as hydrotropic substances. Hydrotropy is the process by which water-insoluble substances are made water-soluble by hydrotropic substances. Such substances include cholic acid, benzoic acid, hippuric acid, phenyl acetic acid and soaps of higher fatty acids.

**Importance of Hydrotrophy :**

- (1) Substances so dissolved by hydrotropy are diffusible through membranes.
- (2) In the body, hydrotropic substances are found not only in bile but also in intestinal juice, extracts of intestinal mucosa, blood plasma and places where such substances are particularly useful in helping adsorption and transport of insoluble substances such as cholesterol and fatty acids formed by digestion.

- (3) The hydrotropic substances have the power of decreasing surface tension, e.g., bile salts reduce the surface tension of fats and help in emulsification for lipase action.

#### **ADSORPTION :**

The process of taking the substances from solution on the surface is called adsorption. Basically adsorption is a surface phenomenon. The extent of adsorption depends on adsorbing agents and the substances being adsorbed. Greater the surface of adsorption agent, greater is the rate of adsorption.

#### **Biological Importance of Adsorption :**

Surface adsorption helps to combine enzymes with substrates to give reaction product. Our body is full of enzymes using several enzyme reactions.

Adsorption processes taking place on the cell membranes promote many vital chemical reactions and also cause changes in surface tension and cell consistency.

Drugs and poisons which are adsorbed on cell surfaces exert that effect from that location. Selective adsorption may related to specific action.

The process of adsorption is applied in the purification of enzymes.

#### **METABOLISM :**

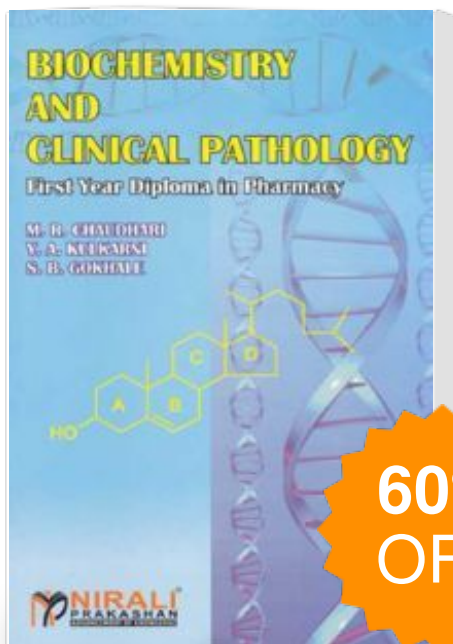
Diet provides all nutrients (chemical substances) needed by biological system or organism. These nutrients are required for growth and to sustain life. In other words, the chemical energy is transformed to biological one and this transformation itself is called metabolism. Thus all biochemical changes are collectively called metabolism. Metabolism consists of two parts :

- (i) Catabolism (ii) Anabolism

**(i) Catabolism :** In this, the degradation of food stuff takes place to generate energy and metabolites, which are required for anabolism. Energy is produced by oxidising proteins, carbohydrates and fats to carbon-di-oxide and water.

**(ii) Anabolism :** Formation of new cells, new molecules and structural and functional units of cell require energy and essential metabolites are derived from diet. It is called anabolism. For example,

# Text Book Of Biochemistry And Clinical Pathology



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Type the URL : <http://www.kopykitab.com/product/20846>



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