

Biochemistry and Clinical Pathology

Theory and Practical Course Codes ER20-23T and ER20-23P

for Diploma in Pharmacy Students

is a concise textbook of biochemistry and clinical pathology with very reasonable emphasis on theoretical and practical courses. It will prove to be very useful not only for the students pursuing diploma in pharmacy but also for the students of other paramedical courses like Bachelor in Physiotherapy, Diploma in Optometry, etc. considering that biochemistry has become the core subject of all the courses in medical and allied health sciences. The text has been written in a lucid and easy to understand language keeping in view the intended readership.

Salient Features

- The text has been written as per the latest syllabus prescribed by Pharmacy Council of India.
- Theory section has been written as per new Course Code ER20-23T
- Practical section has been written as per Course Code ER20-23P
- Appropriate and well-designed diagrams and flowcharts have been included
- Only requisite chemical structures have been given in theory and practical parts; complicated chemical structures have been avoided.
- At the end of each chapter in theory section, important questions which are asked in the university examinations have been given along with relevant MCQs with their answers so as to enhance the knowledge of the students at a glance.
- At the end of each chapter in practical section, 'fill in the blanks' along with their answers have been given so as to enhance the knowledge of practical aspect of students which acts as a ready-reckoner.

SP Singh PhD (Medical Biochemistry); FACBI, recipient of Commonwealth Medical scholarship and WHO fellowship is a biochemist of repute who has served as Professor and Head, Department of Biochemistry, at various government medical colleges in India like Gorakhpur, Agra, Jhansi and Azamgarh.

His total teaching experience is over 46 years, out of which 36 years as head of the department of biochemistry. So far, he has written 34 books, all single-handedly except one. He has written one book of biochemistry in Hindi at the request of HRD Ministry, Government of India; his other book *Manual of Practical Biochemistry* has been translated into Persian. His wide experience of having visited almost every state of India as an examiner of MBBS, MD, BPT, BPharm, DPharm, BSc, MSc, BDS and other such many courses of medical field, led him to gain much experience which he has incorporated in this book.



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Biochemistry and Clinical Pathology

Theory and
Practical

Singh



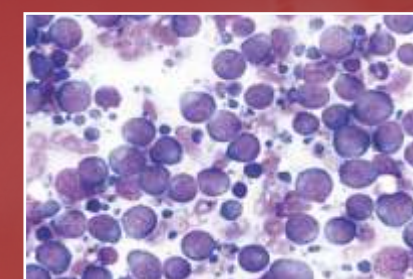
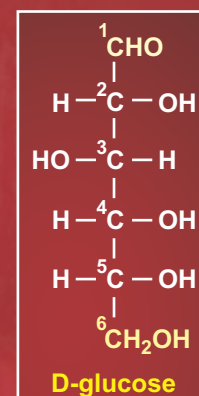
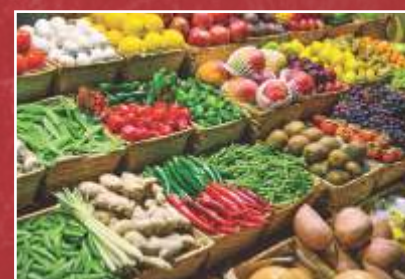
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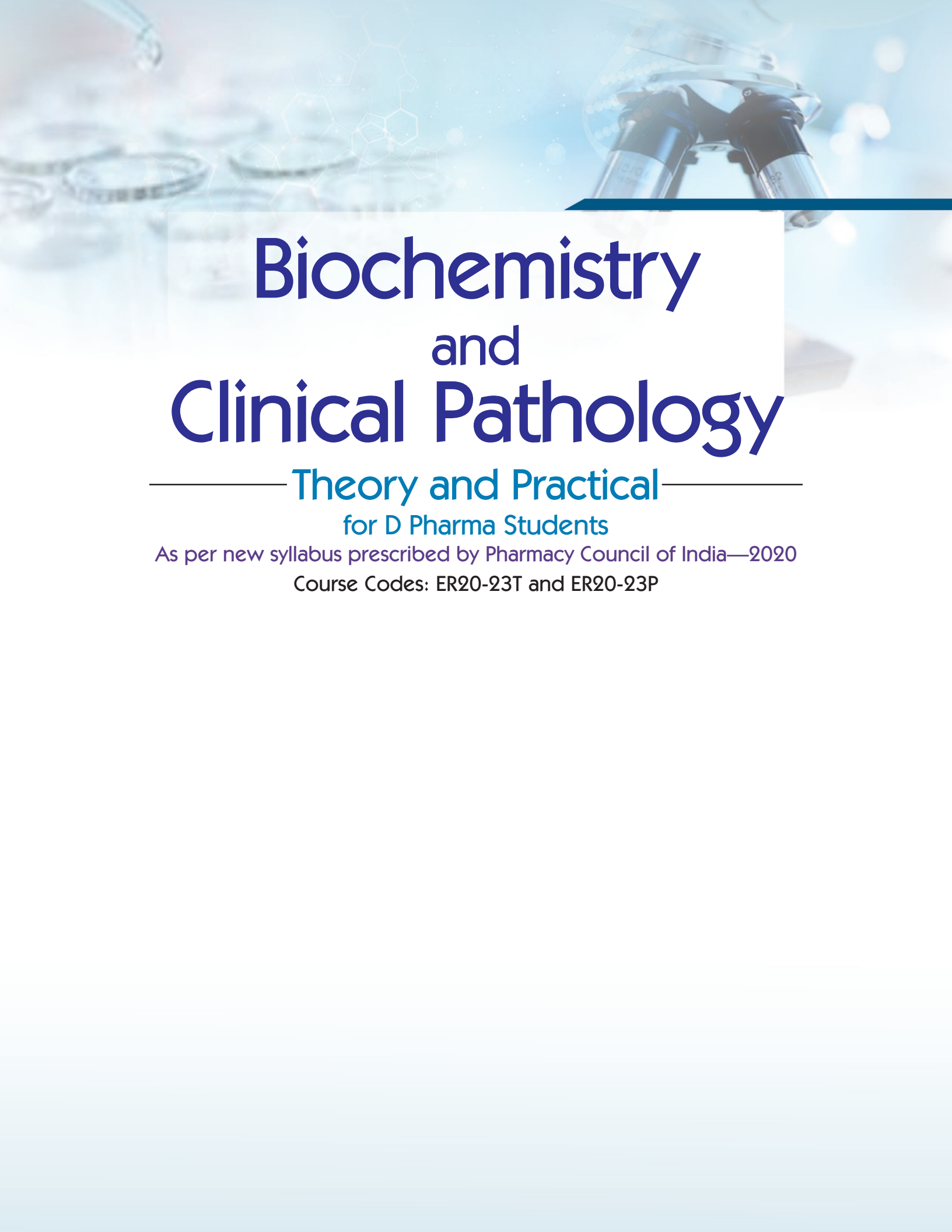


SP Singh



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— Theory and Practical —

for D Pharma Students

As per new syllabus prescribed by Pharmacy Council of India—2020

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— Theory and Practical —

for D Pharma Students

As per new syllabus prescribed by Pharmacy Council of India—2020

Course Codes: ER20-23T and ER20-23P

SP Singh PhD FACBI

Former WHO Fellow, Texas A&M University, Texas, USA, 1984

*Nominated by Government of India for
Commonwealth Medical Fellowship, 1983*

*One of the three members of Medical Council of India for framing
the current New Curriculum of Biochemistry for undergraduate students*

*Ex-Professor and Head, Department of Biochemistry
Government Medical College, Jhansi, UP*

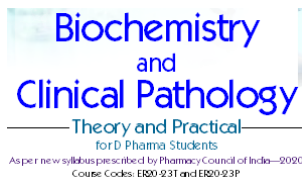


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to

My younger brother



Late Mr Vijai Pal Singh

(1 July, 1950 to 22 April, 2021)

A very pious soul, former Civil Defence Officer,
resident of Pachpera, Katghar, Moradabad, UP

Foreword

Biochemistry is the chemical language of life. It is my pleasure to open a few words on the textbook authored by Prof SP Singh, former Professor and Head, Department of Biochemistry, BRD Medical College, Gorakhpur; SN Medical College, Agra; MLB Medical College, Jhansi; and Government Medical College, Azamgarh.



Prof SP Singh has been a teacher par excellence widely travelled through the length and breadth of India, visited several medical institutions as examiner, visiting professor, expert on the subject and has been widely felicitated. To keep the flame of knowledge burning in the hearts of students, he has written many books in easy-to-understand language. Prof SP Singh is burning his midnight oil to keep the flame of knowledge enlightened infinitely. He has earned a name for himself in the field of biochemistry. His writing skills were first manifested in his book *Manual of Practical Biochemistry* that was the beginning. Subsequently, he authored 9 other original books and *Manual of Practical Biochemistry*. With vast teaching experience spanning over decades with 65 research publications in various national and international journals, Prof SP Singh is presenting his 34th book *Biochemistry and Clinical Pathology*. Dr SP Singh is eminently qualified and is a prolific writer who has gifted this new authentic treasure of knowledge to the students and teachers.

I am glad to note that the present textbook keeps balance between the basic essentials and advanced areas of knowledge in biochemistry and shall prove an asset to the students of pharmacy pursuing diploma course in India and abroad. He has designed this book covering theory and practical aspects taking into account course codes ER20-23T and ER20-23P, recently revised by Pharmacy Council of India.

Prof SP Singh deserves accolades from all the sundry for the enormous pains he took in compiling this useful and voluminous work which will meet the requirements of our diploma-in-pharmacy students. I am pleased to introduce this book to the pharmacy students in particular and to the medical fraternity in general.

With all the humble regards to my *Shradheya Acharya ji*, Prof SP Singh.



Dr Vijai Kumar Singh

Inspector General of Police (Medical)
Composite Hospital, CRPF, Jammu

Foreword

Prof SP Singh, former Professor and Head, Department of Biochemistry, BRD Government Medical College, Gorakhpur; SN Medical College, Agra; MLB Medical College, Jhansi; and Government Medical College, Azamgarh, is a renowned academician, a research scientist, and popular author of world repute. He was able to bring to light the *Manual of Practical Biochemistry* and later he published a title of biochemistry, touching each course of this nice discipline.



Meanwhile, he realized the usefulness of one of his books, *Manual of Practical Biochemistry* which has been translated in Persian language that makes our country's name shine in the Gulf States. In due course, his passion for writing somehow found its way into the records of HRD Ministry, Government of India, New Delhi. One of the concerned officials of that Ministry/Directorate of Hindi section contacted Dr Singh and asked him to write an original book of *Prayogatmak Jeev Rasayan Vigyan* in the national language, i.e. *Hindi*. This textbook of *Biochemistry and Clinical Pathology*, is his 34th book (including editions) of his career.

In 1983, he was nominated for the Commonwealth Medical Fellowship and in 1984, he was the recipient of the WHO Fellowship under which he underwent special advanced training in ocular biochemistry under Professor George Chiou, Department of Pharmacology and Toxicology, College of Medical Sciences, College Station, Texas A&M University, Texas, USA. He is a well-travelled teacher who has visited many countries such as Canada, Germany, Ukraine and Morocco as a guest teacher.

He has a comprehensive record of exams from North-to-South and East-to-West, hence he had the opportunity to interact with MBBS/MD/MSc/BDS/pharmacy/physiotherapy students from all over the country. This type of interactions between a variety of students from all over the country has helped him immensely in finalizing this new book *Biochemistry and Clinical Pathology* as per the latest PCI curriculum which is based on Education Regulation 2020.

I have full confidence in the book *Biochemistry and Clinical Pathology* by a very high level, talented and experienced teacher Dr SP Singh, will surely prove like a fruit-juice for the diploma-in-pharmacy students of our country and abroad.

Wishing him all the best.

With best regards

Prof (Dr) SK Prajapati
Institute of Pharmacy
Bundelkhand University, Jhansi (UP)

Foreword

The book *Biochemistry and Clinical Pathology*, authored by Prof SP Singh is going to be a very useful asset for students of pharmacy. It is designed according to the new syllabus of Pharmacy Education Regulations. Prof (Dr) SP Singh has put a lot of hard work in writing this book and has used his long experience of writing. Prof (Dr) SP Singh has taught medical students for more than 46 years, as Professor and Head, Department of Biochemistry, in BRD Government Medical College, Gorakhpur; SN Medical College, Agra; MLB Government Medical College, Jhansi; and Government Medical College, Azamgarh.



As of now, he has about 34 books (including editions) on his name as an author. One of his books, *Manual of Practical Biochemistry* has been translated in Persian language for which he is also recognized globally in the field of biochemistry. One of his books, *Prayogatmak Jeev Rasayan Vigyan* has been written in Hindi at the request of HRD Ministry, Government of India.

Prof (Dr) SP Singh has 65 research publications to his credit. In the year 1983, he was nominated for Medical Commonwealth Scholarship and again in the year 1984, he was awarded WHO Fellowship for working with Prof George Chiou in the Department of Pharmacology and Toxicology, College of Medical Sciences, Texas A&M University, Texas, USA, with special training in ocular biochemistry. His name is already cited in *Wikipedia* in the year 2010 in the field of biochemistry.

I am glad to pen a foreword to the book *Biochemistry and Clinical Pathology* authored by Prof SP Singh. It is my belief that this book is going to prove to be a boon for the students of pharmacy. This book is written in simple and easy to understand language. All the topics covered in the book are as per the recent syllabus of PCI.

I hope such a magnificent book of biochemistry by a very experienced talented teacher, researcher and author shall prove to be a very useful learning resource for the pharmacy students as well as other students from other medical streams in India and abroad.

Dr Krishan Dev Shakya

Deputy Medical Superintendent
GTB Hospital, Dilshad Garden, Delhi

Preface

I was in fact thinking for long to write a much needed such kind of book for the students of diploma in pharmacy, as I found that only few books on this subject were available in the market and these too not up to the expectations of the students and not as per the latest syllabus of biochemistry which has been recently revised by Pharmacy Council of India in the year 2020 (Course Codes: ER 20-23T and ER 20-23P).

This book has been written taking into account every topic of theory and practical in consonance of the latest revised syllabus by PCI. For grasping and enhancing the knowledge of students at a glance, important questions and multiple choice questions with answers have been incorporated at the end of each chapter which is a unique and salient feature of this book, which one will not find in any such book by any Indian author. I have experienced that MCQ part has become a dire necessity these days in every subject.

I have kept the language of this book very easy and cosy so as to make the subject understandable and more palatable to the students.

I am highly grateful and indebted heartily to my wife Dr Manju Singh, former Professor and Head, Department of History, Bundelkhand University, Jhansi (UP), who helped and assisted me morally and mentally at every juncture while completing this gigantic work of book-writing, as really it is an uphill task for every author to give any book a final shape as it disrupts the functioning and environment of entire family for years and solemnly speaking for wife of every author.

I shall absolutely fail in my endeavour at this prime moment, if I forget to remember my elder brother, late Shri CP Singh, former Director, Cement Research Institute of India, Ballabgarh, Haryana; late Shri IP Singh, former Workshop Manager, Northern Railway Workshop, Kalka (Haryana); younger brother, late Shri Vijai Pal Singh, former Civil Defence Officer, Moradabad (UP); younger sister, late Smt Shakuntala Devi, Bikaner (Rajasthan); younger brother Shri Ajai Pal Singh, former Office Superintendent, Divisional Railway Manager Office, Moradabad (UP).

Again, I am highly thankful to my extreme wellwishers, namely Dr RK Srivastava, former Director-General of Health Services, Government of India and former Chairperson, Medical Council of India and to my few taughts, namely Dr VK Singh, Inspector-General (CRPF, Jammu); Dr Arvind Jain (Plastic Surgeon, Ghaziabad); Dr Rashmi Jain (Gynecologist, Ghaziabad); Dr Krishna Dev Shakya (Medical Superintendent, GTB Hospital, New Delhi); Brigadier Buvnesh Chaudhary (Noida); Dr Vimal Shankar Malik (New Delhi); Dr Mukul Gupta (Physician, Ghaziabad); Dr Pushpendra Kumar Bansal (Pediatrician, Moradabad); Dr Mukesh Kumar Agarwal (Surgeon, Ghaziabad); Dr Vivek Kumar Saxena (Neurologist, New Delhi); Dr Anshuman Singh (Pediatrician, Raebareli); Dr Viresh Mehta (Physician, Max Hospital, Delhi), Dr Laxmi Shankar Chaubey (Ophthalmologist, Varanasi); Dr Pramendra Singh (Surgeon, Varanasi); Dr Ambika Prasad Joshi (DIG, CRPF, Pauri Garhwal); Dr Prashant Saini (CMO, CRPF, New Delhi); Dr Amit Sharma (Cardiologist, Meerut); Dr Vivek Raj Singh (Cardiologist, Varanasi); Dr Vidhya Shankar Pandey (Surgeon, Varanasi); Dr Parul Singhal (Gynecologist, Noida); Dr Sanjay Singh (Orthopedic Surgeon, Bahadurgarh); Dr Sanjeev Singh (Cardiac Surgeon, New Zealand); Dr Vijai Anand (Medicine

Specialist, UK); Dr Subodh Satyarthi (Professor of Cardiac Surgery), Dr Siddhartha Srivastava (Professor of Gastroenterology) and Dr Rachna Wadhwa (Professor of Anesthesiology), all the three from GB Pant Hospital, New Delhi; Prof Rahul Saha (Psychiatrist), and Prof Deepak Sharma, (Orthopedic Surgery), both from Safdarjung Hospital, New Delhi; Dr AP Singh (Physician, Ghaziabad); Dr Yuvraj Sharma (Orthopedician, Ghaziabad); Dr Amit Bathla (Cardiac Surgeon, Ghaziabad); Dr Varnit (Gynecologist, UK) and many others.

I am highly thankful to my colleagues and numerous friends scattered all over the country and abroad for their ideas and for their good wishes, as without the good wishes of colleagues and friends, growth of anything is not so easy, really indebted to them.

I firmly believe that students' wishes and their impetus work a lot for such kind of mountaineering.

It is my pious duty to remember my friends and neighbours of Society, i.e. Mr Dinesh Goel (Advocate), Mr JP Gupta, Mr RK Sharma, Mr PC Kukreti, Mr Rakesh Chaudhary, and Mr Umesh Chandra Chujar who always encouraged me and stood by me like a wall in difficult boring hours.

It shall be unpardonable, if I do not remember at this point my elder son Dr Vikrant Singh, Deputy General Manager (International Marketing), Sonalika Tractors, India, his wife Charu Singh and their children Avvni, Yuvan and Shanaya and younger son Mr Vijyant Singh, M Tech (Senior Technocrat, Erickson Group, Dublin, Ireland and his wife Radha Singh, Senior Data Scientist, Dublin, Ireland and their children Ananya and Anushka.

At the last, I am highly obliged and indebted to [Shri Satish Kumar Jain](#) and [Mr Varun Jain, Proprietors](#), CBS Publishers & Distributors Pvt Ltd, New Delhi, with whom on date I am associated for the last nearly 40 years and on date the seniormost author and to all the staff of CBS family, especially [Mr YN Arjuna](#) (Senior Vice-President, Publishing, Editorial and Publicity), [Ms Ritu Chawla](#) (GM—Production), Mr Neeraj Sharma (Editor), Mr Kuldeep (Typesetter), Mr Rohan (Designer), for their continuous encouragement, guidance and support in completing this very arduous job.

SP Singh

Contents

<i>Foreword by Vijai Kumar Singh</i>	<i>vii</i>
<i>Foreword by SK Prajapati</i>	<i>ix</i>
<i>Foreword by Krishan Dev Shakya</i>	<i>xi</i>
<i>Preface</i>	<i>xiii</i>
1. Scope of Biochemistry and Clinical Pathology in Pharmacy, Cell and Biochemical Organization	1
2. Carbohydrates	16
3. Proteins and Amino Acids	26
4. Lipids	48
5. Nucleic Acids	58
6. Enzymes	69
7. Vitamins	83
8. Metabolism of Carbohydrates	93
9. Metabolism of Lipids	118
10. Metabolism of Amino Acids (Proteins) and Jaundice	128
11. Biological Oxidation	153
12. Minerals	163
13. Water and Electrolytes	175
14. Introduction to Biotechnology	180
15. Organ Function Tests and their Abnormalities	183
16. Pathology of Blood and Urine	189
17. Routes of Drug Administration	196
18. Coronavirus Disease	198

BIOCHEMISTRY PRACTICALS

Procedure of Separation of Plasma and Serum from Blood for Determination of Various Constituents (Quantitative Analysis)	203
Experiment 1 Qualitative Analysis (Tests) of Carbohydrates	204
Experiment 2 Qualitative Analysis (Tests) of Proteins and Amino Acids	209
Experiment 3 Qualitative Analysis (Tests) of Lipids	213

Experiment 4	Urine Analysis (Normal and Abnormal Constituents)	218
Experiment 5(A)	Determination of Glucose in Urine	226
Experiment 5(B)	Determination of Creatinine in Urine	228
Experiment 5(C)	Determination of Chlorides in Urine	230
<i>Blood/Serum Experiments (Simulated/Assumption, i.e. Demonstration only)</i>		
Experiment 6(A)	Determination of Creatinine in Blood/Serum	232
Experiment 6(B)	Determination of Glucose in Blood/Serum	235
Experiment 6(C)	Determination of Cholesterol in Blood/Serum	237
Experiment 6(D)	Determination of Calcium in Blood/Serum	239
Experiment 6(E)	Determination of Urea in Blood/Serum	241
Experiment 6(F)	Determination of SGOT (AST) in Blood/Serum	243
Experiment 6(G)	Determination of SGPT (ALT) in Blood/Serum	246
Experiment 7	Hydrolysis of Starch	248
<i>Index</i>		251