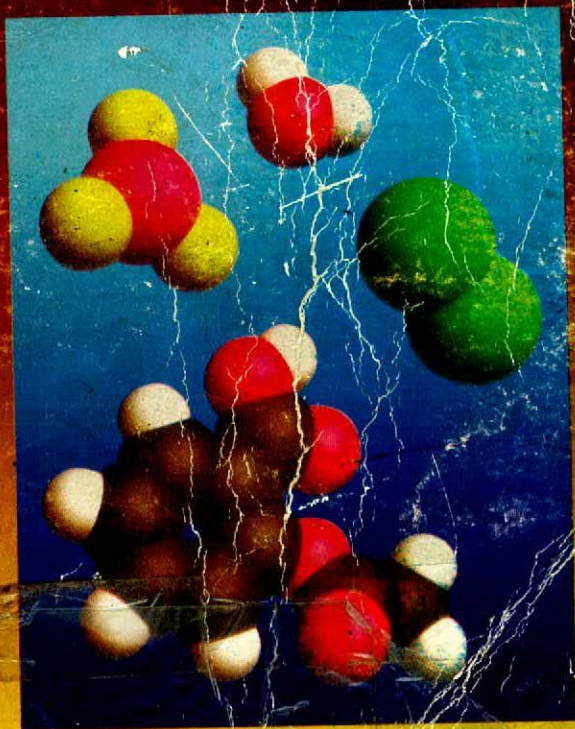


# Advanced Organic Chemistry



**S. CHAND**

**ARUN BAHL  
B.S. BAHL**

**ADVANCED  
ORGANIC CHEMISTRY**

# ADVANCED ORGANIC CHEMISTRY

(For B.Sc. & M.Sc. Students)

**ARUN BAHL**

*MS (Boston), Ph.D (Edinburgh), Chem FRSC (London), FAIC (USA)  
Professor of Organic Chemistry, Panjab University, Chandigarh*

**B.S. BAHL**

*M.Sc. Formerly Principal & Head Postgraduate  
Department of Chemistry, DAV College, Jalandhar*

2010-2011



**S. CHAND & COMPANY LTD.**

**RAM NAGAR, NEW DELHI-110 055**



# S. CHAND & COMPANY LTD.

(An ISO 9002 Company)

Head Office : 7361, RAM NAGAR, NEW DELHI - 110 055

Phones : 3672080-81-82; Fax : 91-11-3677446

Shop at: [schandgroup.com](http://schandgroup.com)

E-mail: [schand@vsnl.com](mailto:schand@vsnl.com)

## Branches :

No. 6, Ahuja Chambers, 1st Cross, Kumara Krupa Road, **Bangalore**-560 001. Ph : 2268048

152, Anna Salai, **Chennai**-600 002. Ph : 8460026

Pan Bazar, **Guwahati**-781 001. Ph : 522155

Sultan Bazar, **Hyderabad**-500 195. Ph : 4651135, 4744815

Mai Hiran Gate, **Jalandhar** - 144008 . Ph. 401630

613-7, M.G. Road, Ernakulam, **Kochi**-682 035. Ph : 381740

285/J, Bipin Bihari Ganguli Street, **Kolkata**-700 012. Ph : 2367459, 2373914

Mahabeer Market, 25 Gwynne Road, Aminabad, **Lucknow**-226 018. Ph : 226801, 284815

Blackie House, 103/5, Walchand Hirachand Marg, Opp. G.P.O., **Mumbai**-400 001. Ph : 2690881, 2610885

3, Gandhi Sagar East, **Nagpur**-440 002. Ph : 723901

104, Ciltcentre Ashok, Govind Mitra Road, **Patna**-800 004. Ph : 671366

© 1977, B.S. Bahl & Arun Bahl

*All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the Publisher.*

First Edition 1977

Subsequent Editions and Reprints 1983, 85, 89, 90, 91, 92, 93, 94, 95, 96,

97, 98, 99, 2000, 2001

Reprint 2003

ISBN : 81-219-0061-1

PRINTED IN INDIA

By Rajendra Ravindra Printers (Pvt.) Ltd., 7361, Ram Nagar, New Delhi-110 055  
and published by S. Chand & Company Ltd. 7361, Ram Nagar, New Delhi-110 055



## PREFACE

This book is written for B.Sc. and B.Sc. (Hons) students. In this New Edition, we have retained all that was judged good in the previous edition, replaced certain chapters considered to be too brief, and added considerable new material. This was the first book on the subject to be adopted by the National Book Trust of India (NBT). This provides enough proof of its Excellence and Quality.

### KEY FEATURES

#### User Friendly

Among students, Organic Chemistry receives a lot of bad press. Traditionally, this subject is considered as an endless amount of material to memorise. To counteract this, many new features have been used to make the material easy-to-understand. For example, the subject is presented in a very systematic manner. Simple language is used. Diagrams/Illustrations are generously used to emphasise reaction sites, to indicate reaction pathways, and to illustrate the geometry of structures. Mechanisms are described in a step-by-step manner.

#### Organisation

The organisation of this book has been guided by our experience of what is helpful to students. Time-tested functional group approach is retained. Chemistry of aliphatic and aromatic compounds is treated separately. It is our belief that a student attains the best grasp of the subject when he masters the behaviour of one family of compounds at a time.

Emphasis is placed on the correlation of the structure of a functional group with its properties. A detailed molecular orbital and valence bond interpretation of the structure of each functional group is given. This enables the student to predict the properties of the functional group. Fundamental principles of energetics, reaction rates, and stereochemistry are provided to lay a strong foundation. Reaction mechanisms are given throughout. An extensive index has been provided for quick cross-reference.

A number of changes have been made in this edition. The subject matter has been updated. The chapter on Nomenclature (Chapter 8) has been expanded. Step-by-step procedures for naming complex organic molecules have been given for the benefit of the students. The chapter on Synthetic Polymers (Chapter 50) has been rewritten. It now includes mechanisms of free-radical and ionic polymerisations. The chapter on Spectroscopy (Chapter 51) has been replaced and now includes a detailed treatment of UV-VIS, IR, NMR, and Mass spectroscopy. The application of spectroscopy in structure determination has been emphasised.

The E, Z system of naming geometrical isomers has been given (Chapter 8). The R,S system has been used to describe the absolute configuration of chiral molecules (Chapter 7). A discussion on the conformations of alkanes with emphasis on Newman projections has been given (Chapter 9). A discussion on the conformations of cyclohexane and its derivatives has been included (Chapter 10). An extensive glossary of important terms has been added.

### **New University Questions**

The style and the level of questions asked in examinations have changed. Latest University Questions are now given to show these trends. Hints/Answers are given for hundreds of questions.

### **Scientific Accuracy and Print Quality**

To improve scientific accuracy and print-quality more than 2000 artist-made diagrams have been included. Key words and definitions are given in bold face. Important points and concepts are highlighted throughout. The subject matter is error-free.

### **We Want You To Succeed**

We are sure you will appreciate the thought and care that has gone into making of this text. The changes that have been made in this New Edition are in response to the suggestions from the users of the previous editions.

This book has everything you want to have in your Advanced Organic Chemistry text. In case you find something missing, please write at the following address : 590, Sector 18-B, Chandigarh-160 018.

We shall be glad to receive suggestions and comments for further improvement.

B.S. Bahl  
Arun Bahl

# CONTENTS

Chapters	Pages
1. Introduction	1
2. Purification of Organic Compounds	6
3. Composition of Organic Compounds	18
4. Empirical and Molecular Formulae : Determination of Molecular Weight	32
5. Structure of Organic Molecules	47
6. Organic Reactions and their Mechanisms A.S	79
7. Isomerism	116
8. Classification and Nomenclature of Organic Compounds	146

## ALIPHATIC COMPOUNDS

9. Alkanes	188
10. Cycloalkanes	218
11. Alkenes	230
12. Alkynes	273
13. Petroleum and Petrochemicals	291
14. Alkyl Halides	309
15. Organometallic Compounds	336
16. Alcohols	351
17. Polyhydric Alcohols	392
18. Ethers	408
19. Organosulphur Compounds —Thioalcohols and Thioethers	420
20. Aldehydes and Ketones — The Carbonyl Compounds	431
21. Carboxylic Acids	479
22. Dicarboxylic Acids	517
23. Substituted Carboxylic Acids	539
24. Functional Derivatives of Carboxylic Acids — Acid Halides, Anhydrides, Ester and Amides	565
25. Esters of Inorganic Acids	602
26. Active Methylene Compounds	613
27. Fats, Oils and Waxes ; Soaps and Detergents	644
28. Aliphatic Amines	699

29. Cyan Compounds	... 711
30. Derivatives of Carbonic Acid	... 728
31. Nitroalkanes, Diazoalkanes and Azides	... 749
32. Carbohydrates	... 768
33. Amino Acids, Peptides and Proteins	... 838
33A. Ureides and Purines	... 863

## AROMATIC COMPOUNDS

34. Introductory — Coal and Petroleum as Sources of Aromatic Compounds	... 875
35. Benzene and its Homologues	... 890
36. Orientation in Aromatic Disubstitution	... 930
37. Aromatic Halogen Compounds	... 945
38. Aromatic Sulphonic Acids	... 963
39. Aromatic Nitro Compounds	... 981
40. Aromatic Amines	... 998
41. Aryldiazonium Salts	... 1029
42. Phenols and Aromatic Alcohols	... 1042
43. Aromatic Aldehydes and Ketones	... 1081
44. Aromatic Carboxylic Acids and Their Derivatives	... 1111
45. Colour, Dyes and Pigments	... 1138
46. Fused Polynuclear Aromatic Hydrocarbons	... 1162
47. Heterocyclic Compounds	... 1201
48. Alkaloids	... 1249
49. Terpenes	... 1272
50. Synthetic Polymers	... 1291
51. Spectroscopy	... 1307
Glossary	... 1343
Index	... 1357