Analytical Chemistry

Skill Enhancement Course

is written according to the UGC syllabus (2015) for all BSc (Honours and General | Programme) students for their Skill Enhancement Course (SEC) under choice based credit system (CBCS) scheme.

All the topics have been well depicted and practice questions are provided at the end of each chapter. Each practical experiment is supplemented with detailed theory, procedure, data representation and calculation. With the help of this book, students can their improve analytical problem solving skill in real field.

Salient features of the book

- Brief and to-the-point discussion
- Simple and lucid style of presentation
- Stepwise instructions for smooth conduct of practical experiments
- Elaborate illustrations, data representation and calculation
- Multiple choice-based questions with answers
- Practice questions with hints.

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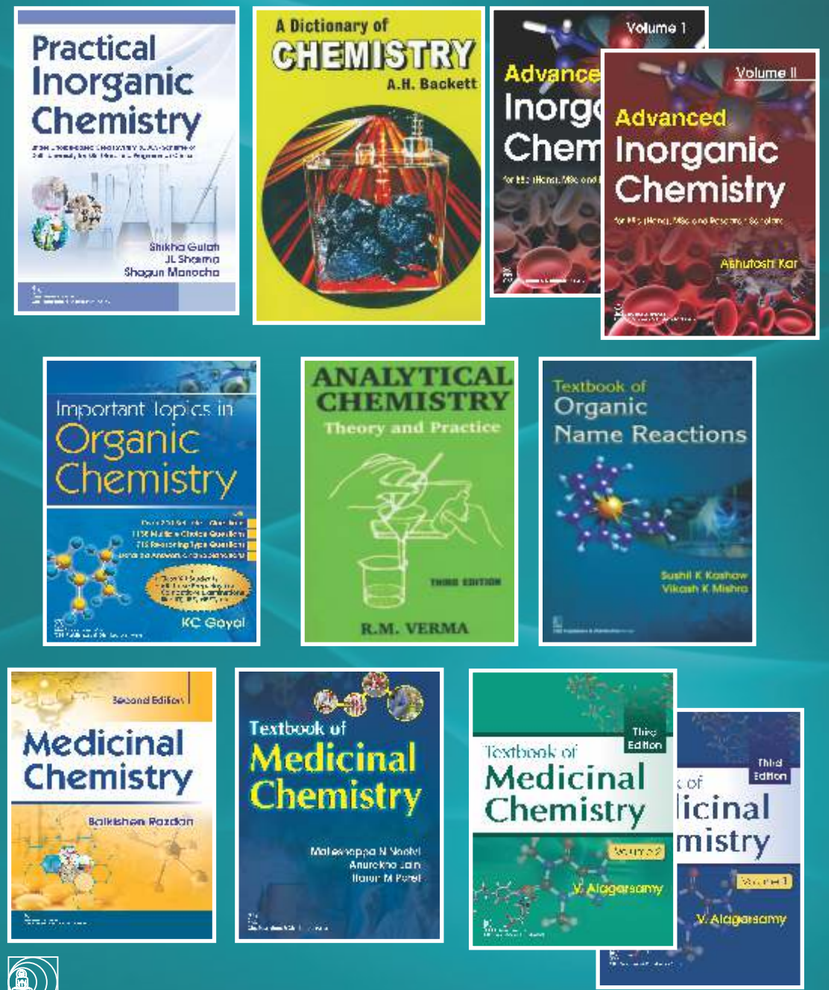

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Analytical Chemistry

ISBN: 978-93-90709-90-8

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First Edition: 2022

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Published by Satish Kumar Jain and produced by Varun Jain for

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Printed at: Glorious Printers, Daryaganj, Delhi, India

to

Our parents
and
Aishani, Ishaan, Mainak, Ankan

Preface

"I am among those who think that science has great beauty. A scientist in his laboratory is not only a technician: He is also a child place before natural phenomenon, which impress him like a fairy tale."

Marie Curie (1867–1934)

It gives us immense pleasure in presenting the book ***Analytical Chemistry*** to all BSc (Honours and General | Programme) students in all the universities in India for their skill enhancement course (SEC). This book is written based on the newly implemented UGC syllabus under choice-based credit system (CBCS) curriculum.

Science is not complete without analysis and one should have the knowledge of analytical chemistry to do the proper analysis. This book includes a detailed discussion on various topics of analytical chemistry, such as analysis methods of soil, water, foods, and cosmetics. Different chromatographic techniques are discussed in detail. The instrumentation of different spectroscopic techniques, such as flame photometer, spectrophotometers is well described with schematic diagram which makes it easy to understand to the readers. The experimental methods in practical part are also well explained in a comprehensible manner.

Following salient features of the book will make it reader-friendly:

- Brief and to-the-point discussion on different sections of analysis increases curiosity among the readers and encourages the students to learn quickly.
- Stepwise instructions for practical experiments help the reader to conduct the experiment smoothly.
- Each chapter includes multiple choice questions (MCQs) and practice questions which will be helpful for the students to prepare for the university as well as different competitive examinations.

We believe that this book will be very useful for the students who even face difficulties to understand this course. Constructive views, suggestions and comments from the readers are most welcome for the improvement of the book.

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Acknowledgements

We are thankful to Prof. Debasish Ray (IIT, Kharagpur), Prof. Swapan Kumar Bhattacharya (Jadavpur University), Prof. Tapan Kanti Paine (IACS, Kolkata) and Prof. Dilip Kumar Maiti (Calcutta University) to their endless encouragements, continuous support and help in acquiring our knowledge we needed to take the next steps toward our dream of writing a book.

We are grateful to all the faculty members of the Department of Chemistry, Sree Chaitanya College, Habra, Kolkata, and all the staff of the college library for their help and inspiration in various ways while writing this book.

We are especially indebted to our parents. Their blessings and love have inspired us to write this book. We express our sincere love to our beloved son Ishaan. Sometimes, we have had to write this book depriving him of his due affection. Hopefully, when he grows up he will understand the importance of our work.

We would like to express our eternal gratitude to our family members for their everlasting love and support. We are also thankful to all of our friends who helped us in every possible way.

We are especially grateful to Mr YN Arjuna (Senior Vice President—Publishing, Editorial and Publicity), Ms Ritu Chawla (AGM—Production) and all the staff of CBS Publishers & Distributors Pvt Ltd for their unwavering support in publishing this book.

The last, but not the least, we thank God for showering His blessings and grace for moving us forward and conceding us the potential to complete the book successfully.

Krishna Chattopadhyay
Manas Mandal

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Syllabus

For BSc (Honours and General | Programme Courses) under CBCS Curriculum of UGC, India [For Delhi University, Calcutta University, West Bengal State University, Burdwan University, Bankura University, etc.]

Skill Enhancement Course
BASIC ANALYTICAL CHEMISTRY
(Credits: 02) 30 Lectures

Introduction: Introduction to analytical chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, concept of pH and pH measurement, complexometric titrations, chelation, chelating agents, use of indicators

a. Determination of pH of soil samples.
b. Estimation of calcium and magnesium ions as calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods.

a. Determination of pH, acidity and alkalinity of a water sample.
b. Determination of dissolved oxygen (DO) of a water sample.

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder, pulses, etc.
b. Analysis of preservatives and colouring matter.

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC, etc.

a. Paper chromatographic separation of mixture of metal ion ($Fe^{3+}$and Al^{3+}).
b. To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography, etc.

Determination of ion exchange capacity of anion/cation exchange resin (using batch procedure if use of column is not feasible).

Analysis of cosmetics: Major and minor constituents and their function

a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
b. Determination of constituents of talcum powder: Magnesium oxide, calcium oxide, zinc oxide and calcium carbonate by complexometric titration.

Suggested Applications (Any one):

a. To study the use of phenolphthalein in trap cases.
b. To analyze arson accelerants.
c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

a. Estimation of macronutrients: Potassium, calcium, magnesium in soil samples by flame photometry.
b. Spectrophotometric determination of iron in vitamin/dietary tablets.
c. Spectrophotometric identification and determination of caffeine and benzoic acid in soft drink.

Abbreviations

2D	Two-dimensional
3D	Three-dimensional
AAS	Atomic absorption spectroscopy
Aq.	Aquous
ASAP	As soon as possible
AW	Atomic weight
BOD	Biological oxygen demand
COD	Chemical oxygen demand
Conc.	Concentrate
DI	Deionized
Dil.	Dilute
DO	Dissolved oxygen
EBT	Eriochrome black T
EDTA	Ethylenediaminetetraacetic acid
GC	Gas chromatography
HPLC	High performance liquid chromatography and Applied Chemistry
IUPAC	International Union of Pure and Applied Chemistry
MP	Melting point
MW	Molecular weight
PE	Polyethylene
pH	Potential of hydrogen
ppb	Parts per billion
ppm	Parts per million
RB	Round bottom
RH	Relative humidity
RO	Reverse osmosis

RSD	Relative standard deviation
SRM	Standard reference material
TLC	Thin layer chromatography
tsp	Table spoon
UV	Ultraviolet
VLC	Vacuum liquid chromatography
WHO	World Health Organization