

New CBCS Syllabus of
Shivaji University, Kolhapur
As per NEP-2020
B.Sc. Part-I : Semester-I

INORGANIC CHEMISTRY

CHEMISTRY (DSC-3A) : PAPER-I

General Electronic Configuration of p-Block Elements

Group	(13) III A	(14) IV A	(15) V A	(16) VI A	(17) VII A
Characteristic electronic configuration	$ns^2 np^1$	$ns^2 np^2$	$ns^2 np^3$	$ns^2 np^4$	$ns^2 np^5$
	B $2s^2 2p^1$	C $2s^2 2p^2$	N $2s^2 2p^3$	O $2s^2 2p^4$	F $2s^2 2p^5$
	Al $3s^2 3p^1$	Si $3s^2 3p^2$	P $3s^2 3p^3$	S $3s^2 3p^4$	Cl $3s^2 3p^5$
	Ga $4s^2 4p^1$	Ge $4s^2 4p^2$	As $4s^2 4p^3$	Se $4s^2 4p^4$	Br $4s^2 4p^5$
	In $5s^2 5p^1$	Sn $5s^2 5p^2$	Sb $5s^2 5p^3$	Te $5s^2 5p^4$	I $5s^2 5p^5$
	Tl $6s^2 6p^1$	Pb $6s^2 6p^2$	Bi $6s^2 6p^3$	Po $6s^2 6p^4$	At $6s^2 6p^5$

Prof. (Dr.) DNYANDEV N. ZAMBARE

Prof. (Dr.) REKHA A. NALAWADE

Prof. (Dr.) PRAVINA B. PISTE

Dr. AVINASH M. NALAWADE

Prof. (Dr.) ARJUN S. KUMBHAR

A Text Book Of
INORGANIC CHEMISTRY

DSC-3A : Paper I
FOR
B.Sc. Part-I : Semester-I

As Per New Revised NEP - 2020 Pattern
Syllabus of Shivaji University, Kolhapur w.e.f. June 2023

Prof. (Dr.) DNYANDEV N. ZAMBARE
M.Sc., Ph.D.

Vice Principal, Professor and Head,
P.G. Recognized Teacher, Research Guide,
Department of Chemistry,
Kisan Veer Mahavidyalaya, Wai.

Prof. (Dr.) REKHA A. NALAWADE
M.Sc., Ph.D.

Professor, P.G. Recognized Teacher,
Research Guide,
Department of Chemistry,
Lal Bahadur Shastri College, Satara.

Prof. (Dr.) PRAVINA B. PISTE
M.Sc., M.Phil, Ph.D.

Professor and Head,
Department of Chemistry,
P.G. and Ph.D. Recognized Teacher,
Rajarshi Chhatrapati Shahu College, Kolhapur.

Dr. AVINASH M. NALAWADE
M.Sc., M.Phil. Ph.D.

Associate Professor,
P.G. Recognized Teacher, Research Guide,
Lal Bahadur Shastri College,
Satara.

Prof. (Dr.) ARJUN S. KUMBHAR
M.Sc., Ph.D.

Professor, DST-SERB Young Scientist,
Department of Chemistry,
Vivekanand College, Kolhapur (Autonomous).

Price : ₹ 80.00

 **NIRALI**
PRAKASHAN
ADVANCEMENT OF KNOWLEDGE

N6564

B.Sc. I : INORGANIC CHEMISTRY (P-I)

ISBN 978-81-19117-22-2

First Edition : August 2023

: Authors

© The text of this publication, or any part thereof, should not be reproduced or transmitted in any form or stored in any computer storage system or device for distribution including photocopy, recording, taping or information retrieval system or reproduced on any disc, tape, perforated media or other information storage device etc., without the written permission of Authors with whom the rights are reserved. Breach of this condition is liable for legal action.

Every effort has been made to avoid errors or omissions in this publication. In spite of this, errors may have crept in. Any mistake, error or discrepancy so noted and shall be brought to our notice shall be taken care of in the next edition. It is notified that neither the publisher nor the authors or seller shall be responsible for any damage or loss of action to any one, of any kind, in any manner, therefrom. The reader must cross check all the facts and contents with original Government notification or publications.

Published By :

NIRALI PRAKASHAN

Abhyudaya Pragati, 1312, Shivaji Nagar,
Off J.M. Road, Pune - 411005
Tel - (020) 25512336/37/39
Email : niralipune@pragationonline.com

Polyplate

YOGIRAJ PRINTERS AND BINDERS

Survey No. 10/1A, Ghule Industrial Estate
Nanded Gaon Road
Nanded, Pune - 411041

Printed By:

DISTRIBUTION CENTRES

PUNE

Nirali Prakashan
(For orders outside Pune)

S. No. 28/27, Dhayari Narhe Road, Near Asian
College Pune 411041, Maharashtra
Tel : (020) 24690204; Mobile : 9657703143
Email : bookorder@pragationonline.com

Nirali Prakashan
(For orders within Pune)

119, Budhwar Peth, Jogeshwari Mandir Lane
Pune 411002, Maharashtra
Mobile : 9657703145, 9890997937
Email : niralilocal@pragationonline.com

MUMBAI

Nirali Prakashan

Rasdhara Co-op. Hsg. Society Ltd., 'D' Wing Ground Floor, 385 S.V.P. Road Girgaum, Mumbai
400004, Maharashtra Mobile : 7045821020, Tel : (022) 2385 6339 / 2386 9976
Email : niralimumbai@pragationonline.com

DISTRIBUTION BRANCHES

DELHI

Nirali Prakashan

Room No. 2 Ground Floor
4575/15 Omkar Tower,
Agarwal Road Darya Ganj,
New Delhi 110002
Mobile : 9555778814/
9818561840
Email : delhi@niralibooks.com

BENGALURU

Nirali Prakashan

Maitri Ground Floor, Jaya
Apartments, No. 99, 6th Cross,
6th Main, Malleswaram,
Bengaluru 560003 Karnataka;
Mob : 9686821074
Email :
bengaluru@niralibooks.com

NAGPUR

Nirali Prakashan

Above Maratha Mandir,
Shop No. 3, First Floor, Rani
Jhanshi Square, Sitabuldi
Nagpur 440012 (MAH)
Tel : (0712) 254 7129
Email :
nagpur@niralibooks.com

KOLHAPUR

Nirali Prakashan

438/2, Bhosale Plaza, Ground
Floor, Khasbag, Opp.
Balgopal Talim,
Kolhapur 416 012,
Maharashtra
Mob : 9850046155
Email :
kolhapur@niralibooks.com

JALGAON

Nirali Prakashan

34, V. V. Golani Market, Navi
Peth, Jalgaon 425001,
Maharashtra
Tel : (0257) 222 0395
Mob : 94234 91860
Email :
jalgaon@niralibooks.com

SOLAPUR

Nirali Prakashan

R-158/2, Avanti Nagar,
Near Golden Gate, Pune
Naka Chowk Solapur
413001, Maharashtra
Mobile 9890918687
Email :
solapur@niralibooks.com

marketing@pragationonline.com | www.niralibooks.com

Also find us on  www.facebook.com/niralibooks

Preface

This book is basically intended for B.Sc.-I students for Semester-I Course of Shivaji University, Kolhapur. This book is written according to new NEP-2020 Pattern syllabus being implemented from June 2023 prescribed by Shivaji University, Kolhapur.

It is our great pleasure to present this book to the students and respected teachers in proper time. The subject matter is presented in simple and lucid language. This book covers all the chapters mentioned in the syllabus. The material is presented in a comprehensive way and the sequence of articles in each chapter helps the students to understand the subject with ease.

Different diagrams and illustrative description is provided to enhance the learning and understanding of the matter by students as well as to enable the teachers to explain the difficult concepts properly. The solved numerical examples, long answer type questions, short answer type questions including multiple type questions are given at the end of each chapter.

We are thankful to Nirali Prakashan, Pune for making us a part of their team of Authors. We thank **Mr. Dineshbhai Furia** and **Mr. Jignesh Furia** for publishing this book.

Last but not the least we are very much indebted to Mr. Virbhaval Shinde (Marketing Executive, Kolhapur District) and Mr. Ashok Nanavare (Marketing Executive, Sangli District) for their nice co-operation. We are very much thankful to Mr. Kiran Kamble (Proof Reading), Mrs. Anjali Muley (Graphic Design) and Mr. Akbar Shaikh for a neat and error free D.T.P. of this book.

We hope that this book will be found useful by students and teachers. We will appreciate any suggestions for the improvement of the book.

Authors



Syllabus

Unit I : Atomic Structure & Periodicity of Elements (08 Hrs.)

- 1.1 Bohr's Theory of Hydrogen Atom and its Limitations
- 1.2 Wave Particle Duality
- 1.3 Heisenberg's Uncertainty Principle
- 1.4 Quantum Numbers and their Significance
- 1.5 Shapes of s, p and d Atomic Orbitals
- 1.6 Electrons Filling Rules in Various Orbitals: (a) Aufbau's Principle, (b) Hund's Rule of Maximum Multiplicity, (c) Pauli's Exclusion Principle
- 1.7 Electronic Configuration of Elements. Stability of Empty, Half-filled and Completely Filled Orbitals
- 1.8 Periodicity of Elements: General discussion of the following Properties of the Elements with reference to s-block elements: (a) Electronic Configuration, (b) Atomic Radii, (c) Ionic Radii, (d) Ionization Energy, (e) Electron Affinity, (f) Electronegativity, (g) Metallic Characters, (h) Reactivity, (i) Oxidation State, (j) Melting and Boiling Points, (k) Chemical Properties.

Unit II : Chemical Bonding and Molecular Structures :

Ionic Bonding

(06 Hrs.)

- 2.1 Types of Chemical Bonds: (a) Ionic Bond, (b) Covalent Bond, (c) Co-ordinate bond, (d) Metallic Bond, (e) Hydrogen Bond, (f) Van der Waal's Force
- 2.2 Definition and Formation of Ionic Bond. General Characteristics of Ionic Bonding
- 2.3 Energetics in Ionic Bond Formation
- 2.4 Born-Haber Cycle for NaCl and its Applications
- 2.5 Fajan's Rule, Applications of Fajan's Rule for
 - (i) Polarising Power and Polarisability
 - (ii) Ionic Character in Covalent Compounds
 - (iii) Bond Moment, Dipole Moment and Percentage Ionic Character

Unit III : Chemical Bonding and Molecular Structures :

Valence Bond Theory (VBT)

(05 Hrs.)

- 3.1 VSEPR Theory
- 3.1 Concept of Hybridisation, Different Types of Hybridisation and Geometry of following molecules:
 - (i) Linear Geometry - BeCl_2 (sp Hybridisation)
 - (ii) Planar Trigonal Geometry - BF_3 (sp^2 Hybridisation)
 - (iii) Tetrahedral Geometry - SiCl_4 (sp^3 Hybridisation)
 - (iv) Trigonal Bipyramidal Geometry - PCl_5 (sp^3d Hybridisation)
 - (v) Octahedral Geometry - SF_6 (sp^3d^2 Hybridisation)
 - (vi) Pentagonal Bipyramidal Geometry - IF_7 (sp^3d^3 Hybridisation)

Unit IV : Acids and Bases

(04 Hrs.)

- 4.1 Theories of Acids and Bases - Arrhenius concept, Bronsted - Lowry concept, Lewis concept, Lux-Flood concept. (Definition and Examples only).
- 4.2 Hard and Soft Acids and Bases (HSAB concept)
 - 4.2.1 Classification of Acids and Bases as Hard Soft and Borderline
 - 4.2.2 Pearson's HSAB concept
 - 4.2.3 Acid - Base Strength and Hardness-Softness
 - 4.2.4 Applications and Limitations of HSAB concept

Unit V : p-Block Elements (Group 13, 14, 15)

(07 Hrs.)

- 5.1 Position of Elements in Periodic Table
- 5.2 Characteristics of Group 13, 14 and 15 Elements with Special Reference to Electronic Configuration and Periodic Properties.
- 5.3 Compounds of Group 13, 14 and 15 Elements.
 - 5.3.1 Boron - Diborane (only Structure).
 - 5.3.2 Allotropes of Carbon and Phosphorus.
 - 5.3.3 Oxyacids of Nitrogen (HNO_2 , HNO_3).



Contents

- | | |
|--|-------------------|
| 1. Atomic Structure and Periodicity of Elements | 1.1 - 1.34 |
| 2. Ionic Bonding | 2.1 - 2.22 |
| 3. Valence Bond Theory (VBT) | 3.1 - 3.28 |
| 4. Acids and Bases | 4.1 - 4.32 |
| 5. p-Block Elements (Group 13, 14, 15) | 5.1 - 5.32 |

Model Question Papers	P.1 - P.4
------------------------------	------------------



About the Authors

Prof. (Dr.) DNYANDEV N. ZAMBARE

M.Sc., Ph.D.

Vice Principal, Professor and Head, P.G. Recognized Teacher, Research Guide,
Department of Chemistry, Kisan Veer Mahavidyalaya, Wai.

Prof. (Dr.) REKHA A. NALAWADE

M.Sc., Ph.D.

Professor, P.G. Recognized Teacher, Research Guide, Department of Chemistry,
Lal Bahadur Shastri College, Satara

Prof. (Dr.) PRAVINA B. PISTE

M.Sc., M.Phil, Ph.D.

Prof. (Dr.) Pravina Piste is Professor and Head, Department of Chemistry, Recognized
P.G. and Ph.D. Recognized Teacher in Rajarshi Chhatrapati Shahu College, Kolhapur.

Dr. AVINASH M. NALAWADE

M.Sc., M.Phil, Ph.D.

Associate Professor, P.G. Recognized Teacher, Research Guide,
Lal Bahadur Shastri College, Satara

Prof. (Dr.) ARJUN S. KUMBHAR

M.Sc., Ph.D.

Professor, DST-SERB Young Scientist, Department of Chemistry, Vivekanand College,
Kolhapur (Autonomous)

BOOKS AVAILABLE AT

PUNE

Nirali Prakashan

: Sur. No. 28/27, Dhayari-Katraj Road, Near Pari Company,
Dhayari, Pune - 411 041. Ph. (020) 24690204
Fax: (020) 24690316 • Email: bookorder@pragationline.com

KOLHAPUR

Nirali Prakashan

: 438/2, Bhosale Plaza, Shop. No. 3, Khasbag,
Opp. Balgopal Talim, Kolhapur. Mob. 9850046155
Email : kolhapur@niralibooks.com

Mehta Book Sellers

: Bhausinghji Road; Kolhapur- Tel. (0231) 2541881

Best Book Suppliers

: Uchgaon, Kolhapur. Mobile : 9860780143

Granth The Book World

: Rajarampuri 5th Lane, Kolhapur. Tel. (0231) 2535355

SANGLI

Nirali Prakashan

: Ashok Ganpati Nanaware, C/o. Sunil Dilip Deshpande,
Sena Maharaj Mandir Road, 1088/A, Gaobhag, Sangli 416416
Mobile : 9921516852

G. R. Tamhankar Book Sellers

: Saraf Naka, Sangli. Tel. (0233) 2329966

Sankpal Book Stall

: Near Church, Kapad Peth, Sangli. Tel. (0233) 3226477

MIRAJ

Ratnakar Book Stall

: Deval Talkies, Miraj. Tel (0233) 2222564

SATARA

Alankar Book Stall

: Opp. Science College, Satara.
Tel (02162) 220456

Email: niralipune@pragationline.com • Website: www.pragationline.com

Also find us on  www.facebook.com/niralibooks

 @nirali.prakashan

