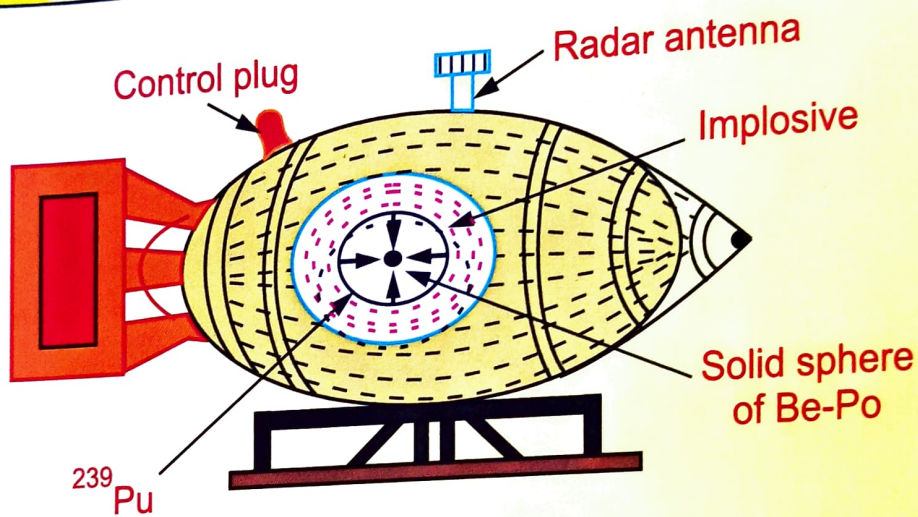


As per New Syllabus  
CBCS Pattern  
of Shivaji University, Kolhapur  
B.Sc. Part-III : Semester-VI

# INORGANIC CHEMISTRY

(CHEMISTRY : DSE-F5 : PAPER-XIII)



Hollow Sphere of Plutonium (A Little Boy)

Dr. DNYANDEV N. ZAMBARE  
Dr. AVINASH M. NALAWADE

Dr. CHANDRASHEKHAR. P. MANE  
Dr. ARJUN S. KUMBHAR  
Dr. PRAVINA B. PISTE

**A Text Book Of**  
**INORGANIC CHEMISTRY**

**DSE - F5 : Paper XIII**

**FOR**

**B.Sc. Part - III : Semester - VI**

**As Per New Revised CBCS Pattern Syllabus of  
Shivaji University, Kolhapur w.e.f. June 2020**

**Dr. Dnyandeve N. Zambare**

**M.Sc., Ph.D.**

Professor

P.G. Recognized Teacher, Research Guide

Department of Chemistry

Kisanveer Mahavidyalaya, Wai

**Dr. Chandrashekhar P. Mane**

**M.Sc., Ph.D.**

Head, P.G. Recognized Teacher

Research Guide

Department of Chemistry

Lal Bahadur Shastri College, Satara

**Dr. Avinash M. Nalawade**

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

Assistant Professor, P.G. Recognized Teacher,

Research Guide

Lal Bahadur Shastri College, Satara

**Dr. Arjun S. Kumbhar**

**M.Sc., Ph.D.**

Assistant Professor

P.G. Recognized Teacher, Research Guide

P.D.V.P. College, Tasgaon, Dist. Sangli

**Dr. Pravina B. Piste**

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

Professor at A.S.C. College,

Ramanandnagar (Burli), Tal. Palus,

Dist. Sangli

P.G. Recognized Teacher and Research Guide

**Price ₹ 100.00**

 **NIRALI**  
**PRAKASHAN**  
ADVANCEMENT OF KNOWLEDGE

**N4855**



**B.Sc. III : INORGANIC CHEMISTRY (DSE- F5 : P-XIII)**  
First Edition : March 2021

ISBN 978-93-5451-083-0

© : 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.

**Published By:**  
**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

**SHREE OM PRINTERS PVT. LTD.**

Survey No. 28/25, Dhayri Near Pari Company

Pune - 411 041

Tel - (020) 24690371

Printed By:

➤ **DISTRIBUTION CENTRES**  
**PUNE**

**Nirali Prakashan** : 119, Budhwar Peth, Jogeshwari Mandir Lane, Pune 411002,  
(For orders within Pune) Maharashtra, Tel: (020) 2445 2044, Mobile: 9657703145,  
Email: niralilocal@pragationline.com

**Nirali Prakashan** : S. No. 28/27, Dhayari, Near Asian College Pune 411041  
(For orders outside Pune) Tel: (020) 24690204; Mobile: 9657703143  
Email: bookorder@pragationline.com

**Nirali Prakashan** : 385, S.V.P. Road, Rasdhara Co-op. Hsg. Society Ltd.,  
Girgaum, Mumbai 400004, Maharashtra;  
Mobile: 9320129587 Tel: (022) 2385 6339 / 2386 9976,  
Fax: (022) 2386 9976  
Email: niralimumbai@pragationline.com

➤ **DISTRIBUTION BRANCHES**  
**JALGAON**

**Nirali Prakashan** : 34, V. V. Golani Market, Navi Peth, Jalgaon 425001,  
Maharashtra, Tel: (0257) 222 0395, Mob: 94234 91860;  
Email: niralijalgaon@pragationline.com

**Nirali Prakashan** : New Mahadvar Road, Kedar Plaza, 1<sup>st</sup> Floor Opp. IDBI Bank,  
Kolhapur 416 012, Maharashtra. Mob: 9850046155;  
Email: niralikolhapur@pragationline.com

**Nirali Prakashan** : Above Maratha Mandir, Shop No. 3, First Floor,  
Rani Jhanshi Square, Sitabuldi, Nagpur 440012, Maharashtra  
Tel: (0712) 254 7129;  
Email: niralinagpur@pragationline.com

**Nirali Prakashan** : 4593/15, Basement, Agarwal Lane, Ansari Road, Dayarganj  
Near Times of India Building, New Delhi 110002  
Mob: 08505972553, Email: niralidelhi@pragationline.com

**Nirali Prakashan** : Maitri Ground Floor, Jaya Apartments, No. 99, 6<sup>th</sup> Cross,  
6<sup>th</sup> Main, Malleswaram, Bengaluru 560003, Karnataka;  
Mob: 9449043034  
Email: niralibangalore@pragationline.com  
**Other Branches: Hyderabad, Chennai**

niralipune@pragationline.com | www.pragationline.com

Also find us on  www.facebook.com/niralibooks

## Preface

This book is basically intended for B.Sc. III students for Semester VI Course of Shivaji University, Kolhapur. This book is written according to new revised CBCS pattern syllabus being implemented from June 2020 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.

We also thank Mr. Girish Redkar (Head Marketing Dept.) for his co-operation in 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 Velankar (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 1 : Coordination Chemistry

### (A) Inorganic Reaction Mechanism

[12]

- Introduction.
- Classification of Mechanism: Association, Dissociation, Interchange and the Rate Determining Steps.
- $S_N^1$  and  $S_N^2$  Reactions for Inert and Labile Complexes.
- Mechanism of Substitution in Cobalt (III) Octahedral Complexes.
- Trans effect and its Theories.
- Applications of Trans effect in the synthesis of Pt(II) Complexes.

### (B) Thermodynamic and Kinetic Aspects of Metal Complexes

- Introduction.
- Thermodynamic Stability.
- Kinetic Stability.
- Relation between Thermodynamic and Kinetic Stability.
- Stepwise Stability Constant.
- Factors affecting the Stability of Complexes.
- Determination of Stability Constant by Job Variation, Mole Ratio and Slope Ratio Method.

## Unit 2 : Nuclear Chemistry

[05]

- Nuclear Reactions and Energetics of Nuclear Reactions.
- Types of Nuclear Reactions.
- Artificial Transmutation.
- Artificial Radioactivity.
- Nuclear Fission and its Application in Heavy Water Nuclear Reactor.
- Nuclear Fusion.
- Use of Thorium, Uranium and Plutonium in Atomic Energy.
- Applications of Radio-Isotopes as Tracers.
- Chemical Investigation – Esterification.
- Structural Determination – Phosphorus Pentachloride.
- Analytical Chemistry – Isotopic Dilution Method for the determination of Volume of Blood.
- Age Determination – Dating by  $C^{14}$ .

## Unit 3 : Chemistry of f-Block Elements

### (A) Lanthanides

- Introduction.
- Occurrence.
- Electronic Configuration.
- Oxidation State.
- Lanthanides Contraction.
- Separation of Lanthanides by Ion Exchange Method.

### (B) Actinides

- Position in the Periodic Table.
- Electronic Configuration.
- General Methods of Preparation of Transuranic Elements.
- Neutron Capture – followed by  $\beta$  decay.
- Accelerated Projectile Bombardment.
- Heavy Ion Bombardment.
- IUPAC Nomenclature of Super Heavy Elements with Atomic Number (Z) greater than 100.

## Unit 4 : Iron and Steel

[07]

- Occurrence and Ores of Iron.
- Definition of Terms - Ore, Mineral, Slag, Flux, Gangue, Matrix, Calcinations, Reduction, Roasting, Smelting and Leaching.
- Extraction of Iron by Blast Furnace.
- Steel : Definition and Types.
- Conversion of Cast Iron into Steel by :
  - Bessemer process.
  - L.D. process.
  - Heat Treatment on Steel.

## Unit 5 : Bio-inorganic Chemistry

[05]

- Introduction.
- Essential and Trace Elements in Biological Process.
- Metalloporphyrins with special reference to Hemoglobin and Myoglobin.
- Biological role of Alkali and Alkaline Earth Metal Ions with special reference to  $Na^+$ ,  $K^+$  and  $Ca^{2+}$ .



# Reference Books

1. Concise Inorganic Chemistry (ELBS, 5<sup>th</sup> Edition) – J. D. Lee.
2. Inorganic Chemistry (ELBS, 3<sup>rd</sup> Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2<sup>nd</sup> Edition.
3. Basic Inorganic Chemistry : Cotton and Wilkinson.
4. Advanced Inorganic Chemistry (4<sup>th</sup> Edition) Cotton and Wilkinson.
5. Concepts and Models of Inorganic Chemistry : Douglas and Mc. Daniel. 3<sup>rd</sup> Edition. John. Wiley Publication.
6. Structural Principles in Inorganic Compounds. W. E. Addison.
7. Theoretical Principles of Inorganic Chemistry – G. S. Manku.
8. Theoretical Inorganic Chemistry by Day and Selbine.
9. Co-ordination Compounds. SFA Kettle.
10. Essentials of Nuclear Chemistry by H. J. Arnika.
11. Nuclear Chemistry by M. N. Shastri
12. Organometallic Chemistry by R. C. Malhotra A. Sing, Wiley Eastern Ltd. New Delhi.
13. Inorganic Chemistry by A. G. Sharpe, Addison – Wesley Longman – Inc.
14. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
15. Text Book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House – New Delhi.
16. Inorganic Chemistry 3<sup>rd</sup> Edition G. L. Miessler and D.A. Tarr, Pearson Publication.
17. Co-ordination Compounds by Baselo and Pearson.
18. UGC Inorganic Chemistry by H.C. Khera, Pragati Prakashan
19. UGC Advanced Inorganic Chemistry by Agarwal and Keemtilal, Pragati Prakashan.

■■■

# Contents

<b>1. Coordination Chemistry</b>	<b>1.1 – 1.40</b>
<b>2. Nuclear Chemistry</b>	<b>2.1 – 2.38</b>
<b>3. Chemistry of f-Block Elements</b>	<b>3.1 – 3.46</b>
<b>4. Iron and Steel</b>	<b>4.1 – 4.36</b>
<b>5. Bio-inorganic Chemistry</b>	<b>5.1 – 5.32</b>

■■■



## About the Authors

### Dr. DNYANDEV N. ZAMBARE

M.Sc., Ph.D.

Professor, P.G. Recognized Teacher, Research Guide, Department of Chemistry, Kisanveer Mahavidyalaya, Wai.

### Dr. CHANDRASHEKHAR P. MANE

M.Sc., Ph.D.

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

### Dr. AVINASH M. NALAWADE

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

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

### Dr. ARJUN S. KUMBHAR

M.Sc., Ph.D.

Assistant Professor, P.G. Recognized Teacher, Research Guide, P.D.V.P. College, Tasgaon, Dist. Sangli

### Dr. PRAVINA B. PISTE

M.Sc., Ph.D.

PG Recognized Teacher, Research Guide

Associate Professor at Y.C. Institute of Science, Satara.

## 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@pragationonline.com

### KOLHAPUR

**Nirali Prakashan**

: New Mahadwar Road, Kedarling Plaza, 1 st floor, Opp. I.D.B.I. Bank, Kolhapur. Mob. 98500 46155

**Mehta Book Sellers**

: Bhausingji Road, Kolhapur. Tel. ( 0231 ) 2541 881

**Granth The Book World**

: Rajarampuri 5 th lane, Kolhapur. Tel. ( 0231 ) 2544 353

**Titus Book Depot**

: Rajarampuri 1st lane, Kolhapur. Tel. (0231) 2522 546

### SANGLI

**Nirali Prakashan**

: Haripur Road, Nandrekar Plot, Sangli. Mob. 99215 16852

**G. R. Tamhankar  
Book Sellers**

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

**Sankapal Book Stall**

: Kapad Peth, Near Church, Sangli.  
Tel. ( 0233 ) 2326447

### MIRAJ

**Ratnakar Book Stall**

: Deval Talkies, Miraj, Tel : (0233 ) 2222564

### SATARA

**Alankar Book Stall**

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

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

Also find us on  [www.facebook.com/niralibooks](https://www.facebook.com/niralibooks)

 @nirali.prakashan

