

PHYSICAL CHEMISTRY IN PRACTICE: THERMODYNAMICS, KINETICS AND QUANTUM THEORY

Dr. Ghamendra Kumar Sahu
Mrs. Ranjeeta Kothari
Mrs. Yamini Sahu



Physical Chemistry in Practice: Thermodynamics, Kinetics, and Quantum Theory



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Physical Chemistry in Practice: Thermodynamics, Kinetics, and Quantum Theory

Authored by:

Dr. Ghamendra Kumar Sahu

Educator and Researcher

Biophysics, Rajnandgaon, Chhattisgarh, India

Mrs. Ranjeeta Kothari

Lecturer in Chemistry

Education Department, Government of Chhattisgarh; Research
Scholar, ISBM University, Gariyabandh, Chhattisgarh

Mrs. Yamini Sahu

Lecturer in Chemistry

Education Department, Government of Chhattisgarh; Research
Scholar, ISBM University, Gariyabandh, Chhattisgarh

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and Mrs. Yamini Sahu

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Preface

Physical chemistry occupies a central position in chemical science, providing the theoretical framework that explains how and why chemical processes occur. It connects observable macroscopic behavior with molecular-level interactions through the language of mathematics and physics. Despite its importance, students often find physical chemistry challenging due to its abstract concepts and quantitative nature. This book has been written with the primary objective of addressing that challenge.

Physical Chemistry in Practice: Thermodynamics, Kinetics, and Quantum Theory is designed to present physical chemistry in a clear, systematic, and student-friendly manner without compromising scientific rigor. The text emphasizes conceptual clarity, logical derivations, and the physical significance of mathematical expressions. Topics such as thermodynamic laws, entropy, free energy, chemical equilibrium, reaction kinetics, and quantum theory are developed step by step to help readers form a coherent understanding of the subject.

The book also highlights the interdisciplinary relevance of physical chemistry in energy science, materials development, environmental chemistry, and industrial processes. Mathematical tools, experimental methods, and data analysis are integrated into the discussion to reinforce the practical and analytical skills essential for modern scientific work.

This book is intended for undergraduate and postgraduate students of chemistry, as well as educators and researchers seeking a reliable reference. It is our hope that this text will not only help students succeed academically but also inspire them to appreciate the elegance and power of physical chemistry in explaining the natural world.

Acknowledgement

The completion of this book would not have been possible without the support, guidance, and encouragement of many individuals and institutions. We express our sincere gratitude to all teachers, mentors, and scholars whose works and insights have contributed to the development of the concepts presented in this book.

We are deeply thankful to colleagues and academic peers for their valuable suggestions and constructive feedback during the preparation of the manuscript. Their critical insights helped refine the structure, clarity, and depth of the content. We also acknowledge the contributions of students, whose questions and learning challenges inspired the pedagogical approach adopted in this book.

Special thanks are extended to the editorial and publishing team for their professional support, patience, and commitment in bringing this work to publication. Their efforts in editing, formatting, and production have greatly enhanced the quality of the final manuscript.

Above all, we express our heartfelt gratitude to our families for their constant encouragement, understanding, and support throughout this endeavor. Their patience and motivation made this work possible.

We hope that this book serves as a meaningful and lasting contribution to the study and teaching of physical chemistry.

Dr. Ghamendra Kumar Sahu
Mrs. Ranjeeta Kothari
Mrs. Yamini Sahu

About The Authors



Dr. Ghamendra Kumar Sahu is an educator and researcher in Biophysics. He was born on 8 October in Rajnandgaon, Chhattisgarh. He holds an M.Sc. in Physics, Ph.D., and B.Ed. His achievements include five granted design patents, one utility patent, one UK design patent, and one copyright. He has published ten research papers in SCI, UGC CARE, and peer-reviewed journals, and has contributed three book chapters. He has participated in ten national and three international conferences, and serves as a member of the editorial board of two science journals. Dr. Sahu has received several awards, including the Young Scientist Award (CGCOST, Government of Chhattisgarh; Government Digvijay PG Autonomous College, Rajnandgaon, Chhattisgarh; and 360 Research Foundation), Bharat Gaurav Samman, Golden Peacock Rashtriya Ratna Award, and Rashtriya Pratishtha Puraskar. He is also the author of the books *Research Methodology (Hindi Language)*, *Wireless Communication and Network, Bastar – Kal, Aaj aur Kal*, and *Fundamental of Modern Physics: Concept, Law and Its Applications*.



Mrs. Ranjeeta Kothari is a Lecturer in Chemistry with eight years of experience in the Education Department, Government of Chhattisgarh, and is currently a Research Scholar in Chemistry at ISBM University, Gariyabandh, Chhattisgarh. She was born in Bhilai, Chhattisgarh. She holds an M.Sc. in Chemistry from Kalyan PG College, Bhilai, Chhattisgarh, and has also completed an M.Sc. in Information Technology from Dr. C. V. Raman University, Chhattisgarh. Her achievements include one granted design patent.



Mrs. Yamini Sahu is a Lecturer in Chemistry with twelve years of experience in the Education Department, Government of Chhattisgarh, and is also a Research Scholar in Chemistry at ISBM University, Gariyabandh, Chhattisgarh. She was born in Rajnandgaon, Chhattisgarh. She holds a Bachelor of Science with specialization in Chemistry, Botany, and Zoology, an M.Sc. in Chemistry from Pt. Ravishankar Shukla University, Raipur, and a Bachelor of Education from Pt. Ravishankar Shukla University, Raipur. Her achievements include two design patents and one copyright.

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ABOUT THE BOOK

Physical Chemistry in Practice: Thermodynamics, Kinetics, and Quantum Theory is a comprehensive and concept-driven textbook designed to provide a strong theoretical and analytical foundation in physical chemistry. The book systematically integrates fundamental principles with mathematical rigor and practical relevance, enabling readers to understand chemical phenomena from both macroscopic and molecular perspectives. Covering core areas such as thermodynamics, chemical kinetics, quantum chemistry, equilibrium, and phase behavior, this book emphasizes clarity of concepts, logical development of laws, and their real-world applications. Special attention is given to foundational topics such as units, dimensions, significant figures, mathematical tools, and experimental methods, ensuring that students build confidence in quantitative reasoning and scientific problem-solving. The text is structured to support undergraduate and postgraduate curricula in chemistry while also serving as a valuable reference for competitive examinations and interdisciplinary learners in chemical engineering, materials science, environmental science, and related fields. Each chapter progresses from basic principles to advanced interpretations, supported by tables, examples, and theoretical explanations that strengthen conceptual understanding. By bridging theory with practice, this book aims to cultivate analytical thinking, deepen scientific insight, and prepare students for both academic research and industrial applications in modern physical chemistry.



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