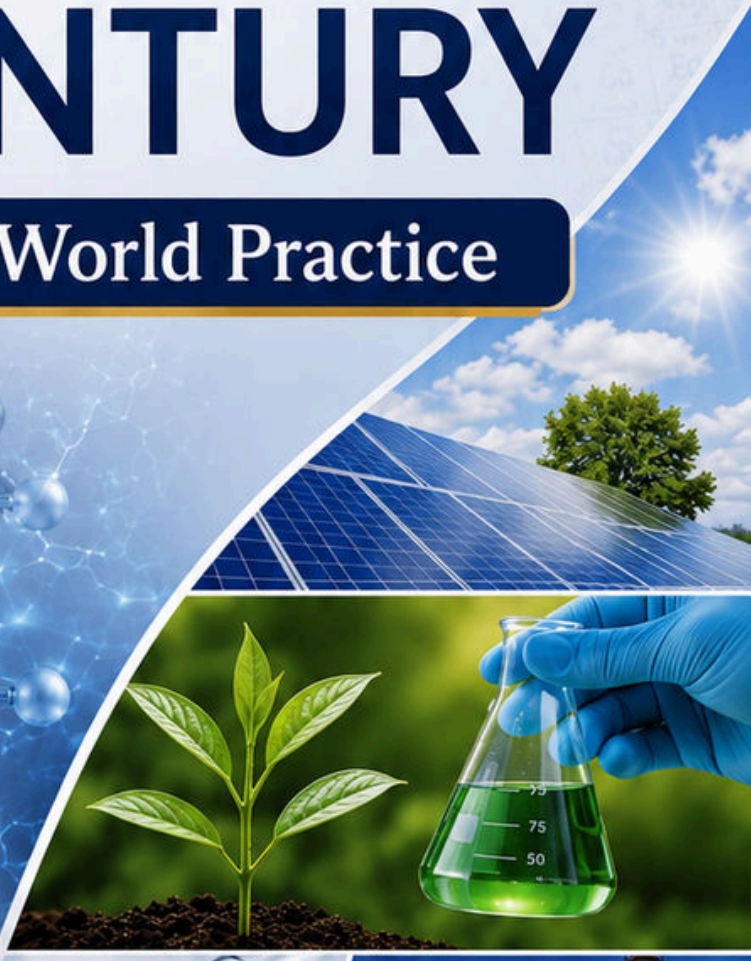
CHEMISTRY IN THE 21ST CENTURY

Theory to Real-World Practice



DISCOVER | UNDERSTAND | INNOVATE | APPLY

Bridging Concepts with Applications for a Better Tomorrow

Mr. Anil Vishwambhar Shinde

Dr. Reema Chhabra

Dr. Abhisek Saha

Chemistry in the 21st Century
Theory to Real-World Practice

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Chemistry in the 21st Century Theory to Real-World Practice

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Preface

Chemistry is one of the most dynamic and interdisciplinary sciences, playing a central role in technological innovation, healthcare, environmental sustainability, energy development, material science, and modern industrial advancement. In the twenty-first century, chemistry has evolved beyond traditional laboratory studies and emerged as a key scientific discipline that contributes significantly to solving global challenges through research, innovation, and sustainable practices.

Chemistry in the 21st Century: Theory to Real-World Practice has been written with the objective of providing a comprehensive understanding of modern chemistry by connecting fundamental theoretical concepts with their practical applications in real-world situations. The book is designed to present complex chemical principles in a simple, systematic, and application-oriented manner suitable for students, teachers, researchers, and science enthusiasts.

The contents of this book cover important areas of chemistry including atomic structure, chemical bonding, states of matter, molecular interactions, nanotechnology, green chemistry, analytical chemistry, material science, sustainable technologies, and interdisciplinary applications of chemistry in modern society. Special emphasis has been given to explaining the relevance of chemistry in healthcare, environmental protection, renewable energy, industrial development, and emerging scientific innovations. This book is the outcome of the combined academic experience, teaching expertise, and research interests of the authors. Every effort has been made to maintain scientific accuracy, clarity of explanation, and academic usefulness. We sincerely hope that this book will serve as a valuable resource for undergraduate and postgraduate students, educators, competitive examination aspirants, and researchers in chemistry and allied sciences. We believe that understanding chemistry is essential for scientific progress and sustainable development, and we hope this book will inspire readers to appreciate the importance of chemistry in shaping the modern world and future technological advancements.

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Acknowledgement

The authors express their sincere gratitude to all those who directly and indirectly contributed to the successful completion of *Chemistry in the 21st Century: Theory to Real-World Practice*.

We are deeply thankful to our teachers, mentors, colleagues, and academic guides for their continuous encouragement, valuable suggestions, and intellectual support throughout the preparation of this book. Their guidance and inspiration have greatly contributed to our academic and research journey.

We also extend our heartfelt appreciation to our respective institutions for providing a supportive academic environment and encouraging research and educational activities. We acknowledge the contributions of researchers, scientists, authors, and publishers whose scholarly works and scientific literature enriched our understanding and helped shape the content of this book.

Special thanks are due to our family members, friends, and well-wishers for their constant support, patience, motivation, and encouragement during the writing and compilation of this manuscript.

Finally, we sincerely thank our students and readers whose curiosity, enthusiasm, and interest in chemistry motivated us to prepare this book in a clear, informative, and application-oriented manner. We hope this work will contribute positively to the learning and advancement of chemistry education and research.

Mr. Anil Vishwambhar Shinde
Dr. Reema Chhabra
Dr. Abhisek Saha

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ABOUT THE AUTHORS

Mr. Anil Vishwambhar Shinde is an accomplished academician, researcher, and author in the field of Chemistry with over 14 years of teaching experience. He completed his M.Sc. in Organic Chemistry from SRTM University, Nanded, qualified CSIR-JRF (NET) and UGC-JRF, and is currently pursuing his Ph.D. from KBCNM University, Jalgaon. He is presently serving as Assistant Professor and Head of the Department of Chemistry at Adiwasi Satpuda Shikshan Prasarak Mandal's Maharaj J.P. Valvi Arts, Commerce & Shri V.K. Kulkarni Science College, Dhadgaon, Maharashtra. Mr. Shinde has published research papers in reputed national and international journals, holds five design patents, and has received several state, national, and international awards for his academic and research contributions. He has actively participated in various conferences, seminars, and symposiums, authored multiple academic books, and is a life member of IIOR and other research organizations.

Dr. Reema Chhabra is an Associate Professor in the Department of Chemistry at Deen Dayal Upadhyaya College, University of Delhi. She has more than 15 years of experience in teaching chemistry at undergraduate level. Dr. Chhabra received her Ph.D from the Department of Chemistry, university of Delhi. Her area of specialization is organic chemistry, with a keen interest in teaching and academic research.

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ABOUT THE BOOK

Chemistry in the 21st Century: Theory to Real-World Practice is a comprehensive and contemporary exploration of chemistry and its transformative role in modern society. The book bridges fundamental chemical principles with real-world applications, demonstrating how chemistry influences technology, healthcare, environmental sustainability, agriculture, nanotechnology, energy systems, and advanced material sciences. Designed for students, educators, researchers, and science enthusiasts, this book presents complex chemical concepts in a clear, structured, and accessible manner. It covers essential topics including atomic structure, chemical bonding, states of matter, molecular interactions, thermodynamics, electrochemistry, nano chemistry, green chemistry, analytical techniques, and modern industrial applications. Each chapter connects theoretical foundations with practical examples from everyday life and emerging scientific innovations. A distinctive feature of this book is its interdisciplinary approach. It highlights the relationship of chemistry with biology, physics, engineering, medicine, environmental science, and computational technologies. Readers gain insight into how modern chemistry contributes to solving global challenges such as climate change, renewable energy development, pollution control, sustainable manufacturing, and healthcare advancement. The book also emphasizes ethical and societal responsibilities in chemical sciences, encouraging responsible innovation, environmental awareness, and sustainable scientific practices. Through detailed explanations and application-oriented discussions, it aims to develop both conceptual understanding and scientific thinking.

Chemistry in the 21st Century: Theory to Real-World Practice serves as both an academic resource and a practical guide to understanding how chemistry shapes the modern world and continues to drive scientific and technological progress in the twenty-first century

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