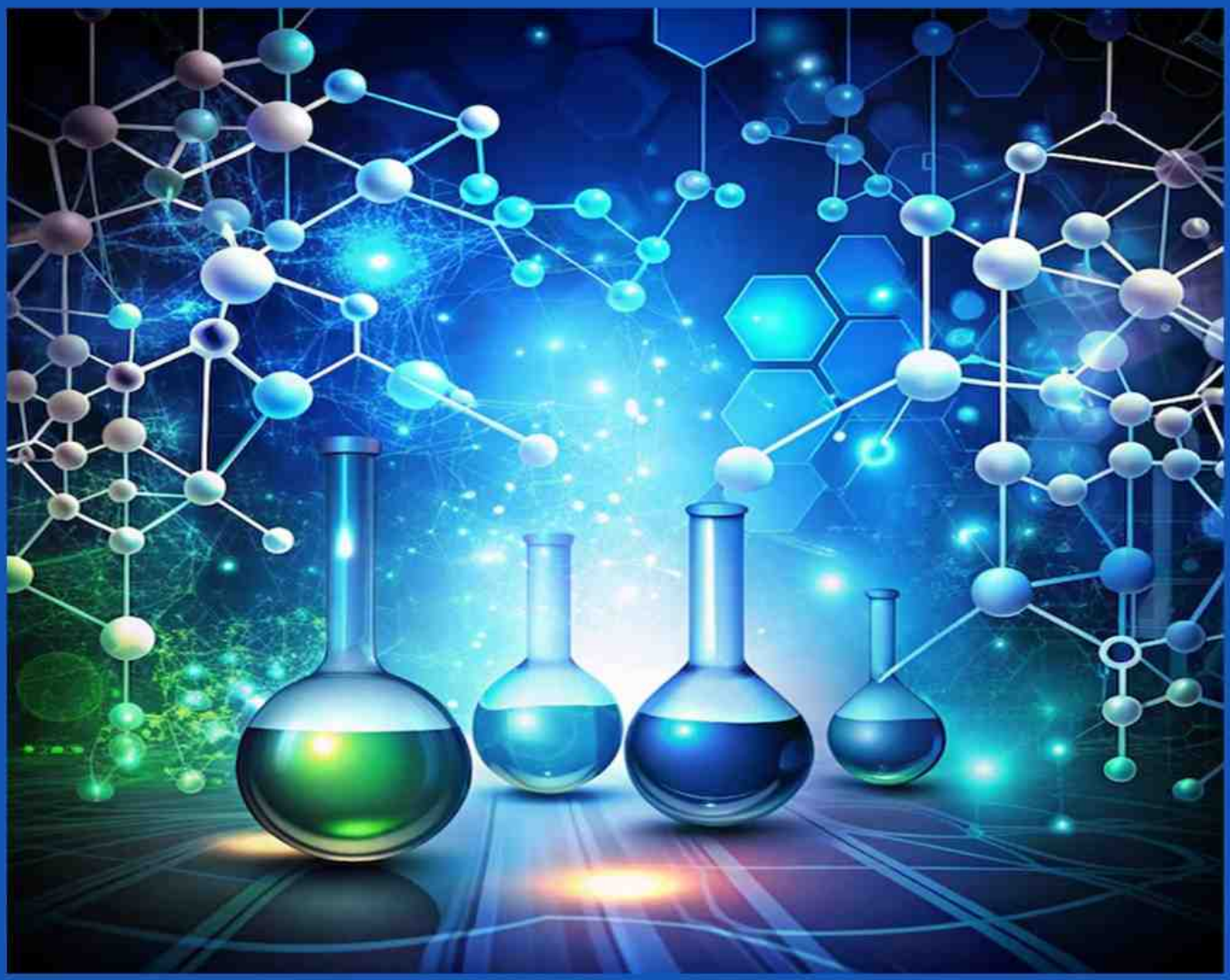
Basic Concepts of

CHEMICAL KINETICS



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Basic Concepts of Chemical Kinetics

First Edition

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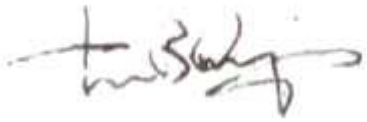
Foreword

Chemical Kinetics, the study of chemical reactions is a well-researched subject all over the world. The book entitled "Basic Concepts of Chemical Kinetics" by Dr. Damodar V Prabhu, Dr. Venkat S Narayan and Dr. HA Parbat and published by Iterative International Publishers (India and USA) discusses in a simple and lucid language the principles of Chemical Kinetics, an important branch of Chemistry with applications in diverse fields.

Starting with rate and order of reaction and integrated rate equations, the authors go on to describe the important theories of reaction rates, kinetics of reactions in solution and kinetics of complex reactions including surface, photochemical and polymerization reactions. Catalysis and Adsorption are an integral part of all reaction studies and hence have been included. Several solved numerical problems are included along with relevant questions and numerical problems at the end of each chapter. The authors have adhered to IUPAC recommendations of nomenclature, units, symbols and nomenclature throughout the book.

The book will be useful to college and university students, teachers and industry chemists and will be a good guide to those who wish to do research in Chemical Kinetics. The unique feature of the book is the clarity with which some of the difficult concepts have been explained. The book is the result of the long years of teaching and research experience of the authors and is a good addition to the literature on Chemical Kinetics.



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Preface

Chemical Kinetics, an important branch of Physical Chemistry is the study of the rates of chemical reactions and is well researched all over the world. A course in Chemical Kinetics is an essential part of Chemistry curricula worldwide. Chemical Kinetics finds important applications in diverse fields such as natural products, health and medicine, reactions occurring in nature like Photosynthesis, proper storage of drugs and pharmaceuticals, preservation of foods and protection of crops.

The aim of this book is to introduce the basic concepts of Chemical Kinetics in a clear and lucid manner and to generate in the reader an interest in the subject. The book will be particularly useful to students who wish to study the fascinating subject of Chemical Kinetics and will serve as an initial guide to those who wish to pursue advanced studies and research in the subject.

The chapters cover integrated rate equations, important theories of chemical reaction rates, Kinetics of complex reactions including photochemical reactions, surface reactions, fast reactions, oscillating reactions, harpoon reactions and surface reactions. Polymerization reaction kinetics has been dealt with in depth. Adsorption and Catalysis are an integral part of all reaction studies and hence have been included. Green catalysts, the new breed of environmentally friendly catalysts are also discussed.

Several solved numerical problems have been included and at the end of each chapter along with relevant questions and numerical problems.

IUPAC recommendations as regards nomenclature, terminology, units and symbols have been followed throughout. A bibliography of useful reference books has been included to motivate the readers to undertake further studies in Chemical Kinetics. Brief biographical sketches of the pioneers of Chemical Kinetics who have contributed to the growth and development of the subject, have also been included.

The book is based on our long years of teaching and research in Chemical Kinetics. We hope the book will be useful to students, researchers and readers with an interest in Chemical Kinetics.

Suggestions for the improvement of the book are welcome

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Contents

ABOUT AUTHORS

Dr. Damodar V. Prabhu received his Ph.D. in Chemistry from University of Mumbai (earlier Bombay), Mumbai and has served as faculty and later Head of the Chemistry Department of Wilson College, Mumbai for nearly four decades. Subsequently he was appointed Adjunct Professor of Chemistry to guide research. He has taught graduate and postgraduate classes and has delivered invited lectures at UGC sponsored Refresher courses for college teachers. He received the Best Chemistry Teacher Award of Chemical Research Society of India in 2006 and was elected Fellow of the Royal Society of Chemistry, London, UK (FRSC) in 2019. Dr. Prabhu's research interests are Reaction Kinetics, Catalysis and Environmental Chemistry. He has worked extensively on Kinetics of oxidation of perfumery alcohols and phenols, Kinetic aspects of hydrolysis of Schiff bases, Homogeneous Catalysis involving transition metal ions and Environmental aspects of sewage disposal in metropolitan cities. Till date, he has to his credit 70 papers published in reputed journals, 15 papers on Science Education, 110 presentations in National and International conferences and 8 ISBN books in Physical and Analytical Chemistry,Advanced Chemical Analysis and Chemical Calculations. His research group has won 7 Best Paper Presentation awards at conferences held in India and abroad. Dr. Prabhu served as the Dean of the Faculty of Science of University of Mumbai in 2005 and was the President of Indian Chemical Society (Mumbai Branch) during 2000-2002. He has been a member of the National Steering Committee appointed by DAE, Government of India to organize Science Olympiads in India. He has served as the Delegation Leader and Mentor of the Indian Teams participating in International Chemistry Olympiads (2001 and 2002) and International Junior Science Olympiads (2013 and 2016). He is the Founder General Secretary of Association of Chemistry Teachers (India), the national registered organization of Chemistry educators of India. Dr Prabhu is the Editor in Chief, GP Globalize Research Journal of Chemistry (ISSN Print 2581 5911), Consulting Editor, GPG Journal of Science Education (E-2582 7073) and Chief Editor, Green Chemistry and Technology Letters (E-2455 3611). He is an Advisory Member, Editorial Board, Accounts of Chemical Education and Research published by Indian Chemical Society.He is a member of the Editorial Board and Panel of Reviewers of many journals. Researchgate Profile : researchgate.net/profile/d-prabhu

Dr. Harichandra A. Parbat received his Ph.D. in Chemistry from University of Mumbai, Mumbai under the guidance of Dr. Damodar V. Prabhu and has served as faculty and now as Associate Professor and Head of the Chemistry Department of Wilson College, Mumbai. He is a recognized Ph.D. guide in Chemistry of Mumbai University, Mumbai. He received his B.Sc. Chemistry degree from Shivaji University Kolhapur and M.Sc.(Physical Chemistry) degree from University of Pune. Dr Parbat is a member of the Physical Chemistry syllabus committee of B.Sc. and M.Sc. Board of Studies of University of Mumbai and Chairperson of Board of Studies in Chemistry, Wilson College, Mumbai. He is a paper setter and syllabus committee member at various autonomous colleges and universities.He has been on the panel of paper setters of the Indian National Chemistry Olympiad. He has served as a subject expert on interview panels for the post of Assistant Professor at CKT College, Panvel; Goregaon College, Goregaon, Raigad and Vaibhavwadi College, Vaibhawadi, Sindhudurg. He is a Resource Person for UGC sponsored Refresher courses at Jabalpur University, (M.P.) on Quantum Chemistry and has delivered guidance lectures on CSIR-UGC-NET, SET and GATE competitive examinations at various colleges and universities. Dr. Parbat's research interests are Reaction Kinetics, Nanoparticles, Nanomaterials Synthesis, Electrocatalysis, Catalysis and Quantum Chemistry. He has worked extensively on Kinetics of oxidation of perfumery alcohols and phenols, Kinetic aspects of hydrolysis of Schiff bases, and Homogeneous Catalysis involving transition metal ions, Photocatalysis, Nanomaterials and Nanocomposite. Till date, he has to his credit 32 papers published in reputed journals, 20 presentations in National and International conferences and 12 ISBN books in Experimental Physical Chemistry and Analytical Chemistry. He has won 2 Best Paper Presentation awards at conferences held in India and abroad.

Dr. Venkat S Narayan did his MSc (Tech.) in Plastics Technology from University of Bombay, Mumbai, India. He obtained his Ph D in Chemistry from Virginia Tech., Blacksburg, Va., USA. He has vast technical expertise and hands-on experience with 1) Synthesis and characterization of engineering and high temperature stable polymers. 2) Small molecule synthesis,characterization and modification for leather processing. 3) Application of thermal and UV processes for optical, ophthalmic and surface coating materials and 4) Design, development, characterization and processing of a variety of polymer materials for medical devices from the R&D bench top to commercial manufacture. Dr Venkat Narayan has 12 US patents in his name ,6 papers in reputed journals and 30 podium and poster presentations in conferences. He is a well known technical executive with extensive experience in Research and Development and has demonstrated leadership and successful team building capabilities, sound technical communication, presentation and personnel development skills. Dr Venkat Narayan is on the Editorial Board of GP Globalize Research Journal of Chemistry (India) and is a reviewer for Polymer Degradation and Stability Journal (Elsevier).He is the Corporate Sponsor of research projects at University of Rochester,N.Y.,Case Western Reserve University,Cleveland,OH. and Dartmouth College,Hanover,NH., for the advancement of polymer materials for use in orthopaedic devices. He is the recipient of several awards including Innotech Presidential Award in 1995 and Johnson Medal for Excellence in Science in 2013.

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