

ACKNOWLEDGEMENT

Getting a Ph.D. is both a rewarding and a roller coaster journey. It's like stepping up a mountain with the help of many people, one step at a time, with bitterness, hardships, frustration, encouragement, and faith. Such a task cannot be completed without the assistance of a small group of people in one's life from time to time. And now it's my chance to express my heartfelt gratitude to all of my loved ones. This thesis is the end of my journey in obtaining my PhD; however, it will be just a stepping stone for me in this vast field of research. And now it's my chance to express my heartfelt gratitude to all of my loved ones who contributed in many ways to this success and those who made it an unforgettable experience for me.

**गुरुर्ब्रह्मा गुरुर्विष्णुः गुरुर्देवो महेश्वरः ।
गुरुः साक्षात् परब्रह्म तस्मै श्री गुरवे नमः ॥**

"Realize that the Guru is Brahma Himself. He is Vishnu and He is also Shiva (Maheshwar). Guru is Parabrahma (Supreme God or the Absolute Truth). With this knowledge, I (salute) offer my obeisance to the Guru."

*First and foremost, I am overwhelmingly and everlastingly grateful to my esteemed guide, guru and idol, **Dr. Sanjeev Kumar**, Associate Professor, Applied Chemistry Department for his valuable guidance, positive approach, inspiration, patience and enduring leniency throughout the course of my work, providing a major momentum which has successfully led me to the completion of this work. This feat was possible only because of the unconditional support provided by him. **Dear Sir**, a person with an amicable and positive disposition, has always made himself available to clarify my doubts despite his busy schedules and I consider it as a great opportunity to do my doctoral programme under his guidance and to learn from his research expertise. Thank you, Sir, for your kind help and support. His unflinching courage and conviction will always inspire me, and I hope to continue to work with his noble thoughts. It has been my privilege to work under his supervision for his*

constant encouragement and constructive criticism. I pray to God to impart you always with good health, peace, achievement and tons of happiness.

It is my privilege to acknowledge **Prof. P. T. Deota**, Head, Applied Chemistry Department, for his understanding, encouragement and personal attention which have provided a smooth basis for my PhD tenure.

I am also grateful and deeply obliged to **Prof. R. C. Tandel**, former Head, Applied Chemistry Department, for his constant encouragement and everlasting moral support.

I would also like to thank **Dr. Chetan K. Modi** (I/C Head), **Dr. Rakesh Sharma**, **Dr. Ran Bahadur**, **Dr. Sandhya Dixit**, **Dr. Pankaj Sharma** and **Dr. Vaishali Suthar** for their kind heartedness and support throughout my research work.

I am grateful to all **teachers** and **professors** for their support and kind suggestion throughout my journey. I am also thankful to all **non-teaching staff** of the Applied Chemistry Department, Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, Vadodara for their kind support.

I am thankful to **Applied Chemistry Department**, Faculty of Technology and Engineering, **The Maharaja Sayajirao University of Baroda** for giving me an opportunity to carry out my research work in the Department with all the facilities available.

Especially, I would like to thank **Prof. (Dr.) Pranav Shrivastav**, Head, Department of Chemistry, Gujarat University, Ahmedabad, for his unwavering support, kind suggestions, and humble nature have been instrumental in shaping my journey. He is not just my mentor; he is my idol. I pray to God to impart you always with good health, peace, achievement and tons of happiness.

My sincere thanks to **Dr. Nitin V. Bhate** (Head, Department of Chemical Engineering), **Dr. Naveen K. Acharya** (Department of Applied Physics), **Dr. Vandana Rao** (Department of Metallurgical and Materials Engineering), Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda for their continuous support for instrumental analysis.

Also, my sincere thanks to **Dr. Bishwajit S. Chakrabarty** (Applied Physics Department), **Prof. (Dr.) Dhanesh Patel** (Dean) from Faculty of Technology and Engineering, The Maharaja Sayajirao University of Baroda, **Dr. Ashwin Prajapati** (Department of Physics), **Dr. Hitesh Parekh** (Department of Chemistry) from S. P.

University, Vallabhvidyanagar, [Prof. Hitesh D. Patel](#), [Prof. M.M. Maisuriya](#), [Dr. Dilip Vasava](#) from Department of Chemistry, Gujarat University for their guidance.

I thank [Ms. Sonal Jadhav](#), [Mr. Mayur Bhai](#), [Mr. Shashikant Bhai](#) (Academic section) and [Ms. Shraddha Ben](#) (Dean's office) for their conducive and friendly support at University Protocols.

I express sincere gratitude to the **Government of Gujarat** and the Knowledge Consortium of Gujarat, Gandhinagar, India, for their financials support through a [SHODH Fellowship Award](#), enabling my dedicated pursuit of research.

ખભા પર હાથ મુકે ને હૈયું હળવું થાય, બસ એનું નામ ભાઈબંધ !!

*“When a hand is placed on the shoulder
with affection, it becomes a blessing; this is simply called brotherhood.”*

This message dedicated to my [PNRV Group](#), a special acknowledgment that goes beyond a mere group, highlighting its familial essence with four cherished members. Commencing with ‘P’, I express my gratitude to my best friend, colleague and brother, [Mr. Pratikkumar Lakhani](#). His unwavering commitment to assisting me with queries, whether related to the intricate steps of my research or personal matters, has been exceptional. Mr. Lakhani has been a constant presence, ever-available, offering his support throughout our collective journey. Together, we have witnessed growth and development. I extend my heartfelt thanks for his consistent encouragement, the creation of a stimulating and enjoyable work environment, and his unique sense of humor that provided moments of levity during challenging times throughout the entire duration of my Ph.D. endeavor. Moving on to ‘N’, I extend my sincere appreciation to [Mr. Navin Chaudhary](#) for his tremendous generosity and unwavering support throughout my research journey. His valuable suggestions, unconditional assistance, and motivating presence have been instrumental in my academic pursuits. Additionally, moving on to ‘R’, I express my gratitude [Mr. Rushikesh Pokar](#), for his outstanding support. I am deeply indebted for the guidance, encouragement, and motivation he provided. And lastly, I express my heartfelt appreciation to ‘V’, representing myself in the ‘PNRV quartet’, Hahaha. Together, we have dedicated nights to collaborative study

sessions, fostering an environment that goes beyond academic endeavors. Their collective contributions, marked by camaraderie and shared experiences, have profoundly enriched my research journey, making it a memorable and fulfilling experience. I am grateful for the support and camaraderie of the entire **PNRV group**, as each member has played a unique and significant role in enhancing my research and personal growth.

It's my fortune to gratefully acknowledge the support of some special individuals. I am immensely grateful to my best **colleague Ms. Darshna Hirpara** who has always supported me on each and every aspect of my research work. She was so inspiring all the time and a person who is always spreading smile in every situation. I am glad to have a colleague/friend like her who has always encouraged for the best. Being a very cooperative, caring and supportive friend, she has actually kept me away from losing spirit. A heartfelt shoutout to my foodie companion, **Ms. Kishu Hirpara**. Thank you for sharing meals, and cherishing good moments together.

I want to express my sincere appreciation to **Ms. Komal Trivedi** and **Mr. Dhaval Bhandari** for her support throughout my research journey. Her valuable insights and assistance, related to my research, have had an impact on my work.

Our lab has been a very magnificent place and it is joyful to have many crazy people over all these years coming under the same roof. My acknowledgement will never be completed without my **research lab mates**, **Mr. Vikash Ganvit**, **Ms. Megha Rathwa**, **Mr. Sagar Bairwa**, **Mr. Saurav Patel**, **Mr. Meet Thakkar**, **Mr. Hemil Patel**, **Mr. Gaurang Bhatt**, **Mrs. Urvi Lad**, **Mr. Bharat Maru**, **Ms. Smita Katariya**, **Mr. Srujal Sonera**, **Mrs. Dixita Prajapati**, **Mrs. Bhavita Mistry**, **Ms. Priyanka Mistry**, **Mrs. Nidhi Prajapati**, **Mr. Aakash Patel**, and **Ms. Nidhi Kahar**. I would like to thank all the **M. Sc dissertation students** for being supportive, enthusiastic, party makers and outing sources.

I thank my **lab seniors**, **Mr. Brijesh Patel**, **Dr. Sneha Singh**, **Dr. Kushan Parikh**, **Dr. Sanjay Kumar Yadav**, **Dr. Arti Bhadouria** and **Dr. Harsha Patel**, for their continuous support during the entire journey of Ph.D.

Also, thanks to my good friends from other departments in the **Science Block**, **Dr. Avani Patel**, **Ms. Neha Barad**, **Mr. Kaushal Agheda**, **Mrs. Smruti Parikh**, **Mr. Dhaval Chauhan**, **Dr. Kevil Shah**, **Mr. Subhash Utadiya**, **Ms. Margi Patel**, **Ms. Pinal**, **Ms. Shivani Patel**, **Mr. Ravi Chudasama (Applied Physics)**, **Ms. Janvi Ingle (Civil Engineering)**, **Mr. Anil**

Chavda, Mr. Kuldeep Chaudhary, Dr. Pooja Shah and Mr. Amar Mangrola (Applied Mathematics) for their incredible support. They've been my go-to squad, helping me navigate through non-chemistry doubts and sharing in moments of joy. Grateful for their diverse perspectives and unwavering friendship that made my academic journey richer. I'm very thankful to Mr. Kanu Kaka for cleaning the science block and labs.

I shower love to all my hostel friends Mr. Jignesh Gamit, Mr. Narotam Priyadarshi, Mr. Pravin Patil, Mr. Sanjay Bambhaniya, Mr. Brajesh Bhagat, Mr. Aman Morya, Mr. Karan Joshi, Mr. Kishan Mali, Mr. Pankaj Sharma, Mr. Krupal Patel, Mr. Dhaval Bhatt, Mr. Parth Soni, Mr. Naresh Degda, Mr. Milan Joshi, Mr. Palkesh, Mr. Parikshit Dhaduk and Mr. Jayvandan Vaishnav from V.S. Hall, for not letting me feel homesickness. Together, we've shared laughter and created cherished memories, making every day a special and unforgettable one. Also, I would like to thank Dr. Sanjay Solanki (Warden), Mr. Smudrabhai, Mr. Ashokbhai and Mr. Rameshbhai for helping during hostel time.

A special thanks to my personal mentor and collaborator, Dr. Priyanka Shah, National Forensic Science University, Dharwad, who has been my guiding light throughout the stages of my Ph.D. Her unwavering support, guidance, and motivation have been instrumental in my journey. Grateful for her encouragement and constant push to strive for excellence.

I would also like to thank Dr. Pranav Pandya, Dr. Anargha Nambiar, Dr. Archana George, Ms. Priyanka Kashyap for their constant support and guidance till the end.

I would also thank to Ms. Shreya Chakraborty (VIT, Vellore), Ms. Shabnam Mansuri (IIT-Gandhinagar), Ms. Aayushi Joshi (PDPU Gandhinagar) and Mr. Harsh Patel (Applied Physics-MSU Baroda) for helping me in instrumental analysis.

Expressing gratitude to my friend from M.Sc. days Ms. Veena Sodha, Ms. Trusha Lodha, Mr. Jigar Barot, Ms. Dhara Lad, Mr. Yash Patel, Ms. Hetvi Patel, Mr. Mohit More, Mr. Ronak Patel, Mr. Ephraim Koorapetse, Mr. Pravin Solanki and Mr. Brij Patel.

A heartfelt thanks to my school teacher, Mrs. Priyanka Patel, Sarkhej Higher Secondary School, whose guidance has been a beacon since my school days. Her teachings laid a strong foundation, shaping my academic journey.

I would like to also thank all the Professors, Ms. Shreya Patel, Ms. Nidhi Shah and my batch mates from PG diploma IPR for help and support throughout this PGDI PR course work,

A special thanks to my best friend, Ms. Ritu Prajapati, a constant pillar of support through thick and thin. Her unwavering presence, encouragement, and motivating words, 'Vishwa, you can do it,' have been my driving force. Grateful for a friend who provides strength and motivation in every situation. To my dearest friend, you've been my rock, my confidant, and more than just a friend – you're family. In times when I felt done with drama, you stood by me. Your readiness to talk and ability to change my mood make you irreplaceable. Thank you for being my constant.

A heartfelt thank you to my friend Ms. Maitri Desai, my go-to gossip partner and unwavering support. In every situation, her advice, both personal and academic, has been invaluable. Her talent is inspiring, and I've learned so much from her. Grateful for a friend who enriches my life in so many meaningful ways.

A big thank you to Ms. Pinky Yadav. Your silly jokes and unwavering support never fail to lighten my mood and bring positivity.

Grateful to Mr. Prakash bhai for providing tea, essential for sustained productivity, and to Mr. Iqbal bhai (KAKA) for morning breakfast, both crucial for our work routine.

Also, grateful for my furry partner – a heartfelt thank you to my Dog (Raju). Always ready for a biscuit break, your playful interruptions bring moments of joy amid intense study sessions.

मातृदेवो भव। पितृदेवो भव।

"Mother is equivalent to god, and father is equivalent to god."

I would like to express my heartiest gratitude and thanks to my loving and caring family for their enormous support during the journey. They have constantly been a source of inspirations no matter whatever situation befall me they stood behind me to support and encourage me. The word "Thank you" would be too small to define their hard work and sacrifices to see me in this state as of today. Seeing their zeal, I could keep on going in my Research life and complete the journey successfully.

I heartily remember and adore my grandparents Bapuji (Shri. Mobatsinh B. Chavda) and Ba (Lt. Smt. Jikuba M. Chavda) for sowing spirituality during my upbringing. I remember my Bapuji (Lt. Shri Parshottam Padhiyar) with my tears in eyes who used to call me "Doctor saheb" since I got register for my doctoral study. Also, take heartily blessings of my Ba (Smt. Kamalaba P. Padhiyar).

I adore my Pappa, Mr. Ranjitsinh M. Chavda and Mummy, Mrs. Meenaba R. Chavda for teaching me practical aspects of life which made me stronger in this journey. However, my words can't express gratitude to my parents for whatever they have given me since my birth. I adulate my brother, Mr. Vijayraj R. Chavda and sister-in-law, Mrs. Rajnandani V. Chavda for their tireless hopes, suggestions, enormous support and taking on responsibility at home in my absence. Oh, I forgot to mention a very important person who is a significant part of my life – my love, my joy, my happiness, my mood changer, my everything: my niece, Ms. Ruhi Chavda. She was just 3 months old when I started my PhD, and now she is 3 years old. I always do video calls whenever I am tired and sad, and she always tells me, "KAKU, Su Karo Cho!" and all my tiredness disappears. She is an ice cream and chocolate lover, but I am her lover, for sure. Thank you for coming into my life, Ruhi baby! I love you!

Finally, I thank one and all in case I forgot to mention who have helped me complete my Ph.D. work, I feel happy and lucky to have enormous support from all dimensions at the end of the journey. Last but not the least I would like to thank Almighty God for giving me the strength to complete my doctoral study and stand up to all the expectations of my family and teacher.

- Vishwajit R. Chavda