THIS THESIS IS

DEDICATED TO MY

BELOVED PARENTS, SISTER

AND

MY RESPECTED SUPERVISORS

FOR THEIR CONSTANT INSPIRATION, WHOLE HEARTED COOPERATION AND PROPER VALUABLE GUIDANCE

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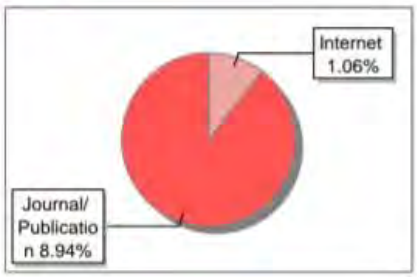

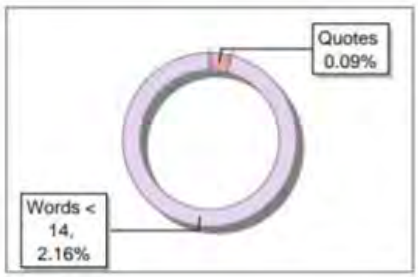

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CERTIFICATE

I, certify that Mr. Subhajit Debnath has prepared his thesis entitled *"Assorted Interactions of Some Noteworthy Compounds Prevailing in Host Guest and Solution Chemistry Investigated by Physicochemical Contrivance"*, for the award of **Ph.D. degree (Doctor of Philosophy)** from the University of North Bengal, under our guidance. He has carried out his work at the Department of Chemistry, University of North Bengal. The contents of this thesis, in full or in parts, have not been submitted to any other Institution or University for the award of any degree or diploma.

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CERTIFICATE

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Dated: 09-04-24

DECLARATION

I declare that the thesis entitled ***"Assorted Interactions of Some Noteworthy Compounds Prevailing in Host Guest and Solution Chemistry Investigated by Physicochemical Contrivance"*** has been prepared by me for the degree of **Doctor of Philosophy (Ph.D.)** under the supervision of **Dr. Mahendra Nath Roy, FRSC (London)**, **(Principal Supervisor)**, Professor of Chemistry, University of North Bengal and *Dr. Anuradha Sinha*, (Co-Supervisor), Associate Professor of Chemistry, Siliguri College. No part of this thesis has formed the basis for the award of any other degree or diploma, in this or any other Institution or University.

Subhajit Debnath.

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DATE: 09-04-24

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First and foremost, praises and thanks to the Almighty God for his blessings throughout my research work to complete my research successfully.

First of all, I would like to convey my deepest sense of gratitude to my respected Supervisor, ***Dr. Mahendra Nath Roy, FRSC (London)***, Professor of Chemistry, University of North Bengal, West Bengal, India. Throughout my research phase, I have received constant supervision, valuable suggestions and inspiration from him in every possible way. I feel blessed and privileged to have finished my thesis under his guidance, who trusted me completely and gave me the independence to explore different ideas of my own. Without his continuous encouragement, responsible guidance, and priceless supervision, the research work associated with this thesis would not have been possible.

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My sincere appreciation goes to my family and friends for their unwavering support and encouragement throughout my academic journey. Their love and care have been a constant source of strength and motivation.

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support, encouragement and contributions to building my career, and their continuous inspiration went a long way to the completion of the thesis. Without their constant support, I would not be where I am now. My heartfelt thanks to my maternal uncle, *Sri. Soumen Debnath*, aunt-in-law, *Bobita Debnath Roy,* brother-in-law, *Sri. Biswanath Saha* and all other family members for their kind cooperation.

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I express my special thanks to the editors, co-editors, and reviewers of my publications as their comments and suggestions have also been valuable for carrying out the research work. All the cited references are the major sources of information that help us to develop new ideas, hence, all the authors/ researchers behind the cited works are hereby sincerely acknowledged.

I must acknowledge all my respected teachers who taught me at Dinhata Soni Devi Jain High School, Dinhata College, Coochbehar, and the University of North Bengal. The knowledge I received from them has helped me to carry out my research work.

Finally, I would like to express my gratitude to the participants of this study, without whom this research would not have been possible. Their willingness to share their experiences and insights has enriched this work and contributed to the advancement of knowledge in this field.

Thank you all for your invaluable contributions to this thesis.

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PREFACE

The research work in the thesis entitled ***"Assorted Interactions of Some Noteworthy Compounds Prevailing in Host Guest and Solution Chemistry Investigated by Physicochemical Contrivance"*** was initiated under the supervision of ***Dr. Mahendra Nath Roy,*** **FRSC (London)**, **(Principal Supervisor)**, Professor of Chemistry, University of North Bengal and *Dr. Anuradha Sinha* (Co-Supervisor), Associate Professor of Chemistry, Siliguri College.

The whole work is an attempt to explore the supramolecular inclusion complexation of some biologically active molecules such as drugs, vitamins, and ionic liquids to make them more bioavailable by increasing their biological activity such as antibacterial activity and MTT assay without any chemical modification of the bioactive molecules. Besides this, we investigated molecular interactions between amino acid-ionic liquids in an aqueous medium by studying their physicochemical properties.

During the course of my research, I was privileged to participate in several meetings and seminars across the country. I was highly inspired by listening to and interacting with distinguished experts and scientists. I was very fortunate enough to publish my research works relating to the thesis in the International and National Journals of repute which are included in the thesis.

In keeping with the general practice of reporting scientific observation, due acknowledgment has been made whenever the work described was based on the findings of the other investigators. I must take responsibility for any unintentional oversights and errors, which might have sneaked despite precautions.

I hope I will be given more challenges in my life so that the knowledge that I have earned during my work can be put into action in the future.

LIST OF TABLES

LIST OF FIGURES

LIST OF SCHEMES

ABBREVIATIONS

CD	Cyclodextrin
α-CD	α-cyclodextrin
IC	Inclusion complex
MEP	Mephenesin
$[Bdmim]BF_4$	1-butyl-2, 3-dimethyl imidazolium tetrafluoroborate
BTBACl	Benzyltributylammonium chloride
BTBAC	Benzyltributylammonium chloride
BTEAC	Benzyltriethylammonium chloride
Vit C	Vitamin C
IL	Ionic liquid
AA	Amino acid
µm	Micrometre
Å	Angstrom
C	Carbon
H	Hydrogen
O	Oxygen
Cm	Centimetre
EtOH	Ethanol
Eq.	Equation
eV	Electron Volt
Fig.	Figure
ESI-MS	Electron Ionization Spray- Mass Spectrometry
g	Gram
hrs	Hours

Hz	Hertz
FTIR	Fourier Transform Infrared spectroscopy
K	Kelvin
M	Molar
m	Meter/Molality
mg	Milligram
min	Minute
mL	Millilitre
µM	Micromolar
µL	Microlitre
^{0}C	Degree Celsius
rpm	Revolutions Per Minute
SEM	Scanning Electron Microscopy
TGA	Thermogravimetric Analysis
DSC	Differential Scanning Calorimetry
UV-vis	Ultraviolet-visible
NMR	Nuclear Magnetic Resonance
XRD	X-Ray Diffraction

APPENDIX-A

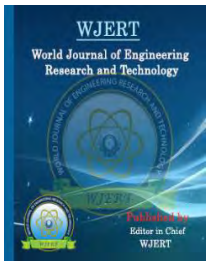
LIST OF PUBLICATIONS

1. **S. Debnath,** M. Mondal, A. Sinha, N. Roy, B. Ghosh, K. Mallick, B. Rajbanshi, D. Roy, T. Ray, S. Sarkar, J. Maji and M. N. Roy, Physicochemical Contrivance for Exploring Host-Guest Inclusion Complex of a Significant Green Solvent with a Cyclic Oligosaccharide and its Innovative Application Optimized by Computational Approach.

Zeitschrift für Physikalische Chemie, 2023, (ahead-of-print)

(Included in the Thesis)

2. **S. Debnath,** A. Poddar, A. Sinha, A. Hossain, B. Ghosh, S. Majumder, M. Mondal, N. Roy, B. Rajbanshi and M. N. Roy, Physicochemical investigation of diverse interactions of some biologically potent molecules in aqueous green environments at different temperatures.



World Journal of Engineering Research and Technology, 8, 10, (2021) 90-111

(Included in the Thesis)

3. **S. Debnath,** A. Sinha, H. Rahaman, S. B. Neogi and M. N. Roy, Investigation of Assorted Interactions of Vitamin-C Prevalent in Two Ionic Liquids Aqueous Solutions at Different Temperatures.

Journal of Chemical, Biological and Physical Sciences, 14, 1, (2024) 11-30

(Included in the Thesis)

4. K. Mallick, M. Mondal, D. Roy, P. Roy, S. Ali, D. Roy, B. Saha, S. Choudhury, **S. Debnath,** N. Roy, S. Saha and M. N. Roy, Exploring Various Molecular Interactions of Two Essential Amino Acids Prevalent in Aqueous Solutions of an Ionic Liquid by Density, Viscosity, Refractive Index, Conductance, Surface Tension, Nuclear Magnetic Resonance, Ultraviolet, and Computational Studies.

Journal of Chemical & Engineering Data, 68, 12, (2023) 3045-3061

5. F. Alam, S. B. Neogi, A. Das, **S. Debnath,** A. Poddar, D. Roy, A. Hossain, M. Kundu, D. Roy, A. Tudu, K. Mallick and M. N. Roy, Probing Diverse Interactions of Model Amino Acids Prevalent in Aqueous Solutions of Anti-Histaminic Drug by Physicochemical Contrivance.

Journal of Chemical, Biological and Physical Sciences, 13, 2, (2023) 201-234

6. P. Karmakar, B. Rajbanshi, S. Ray, D. Das, M. Dey, S. Das, I. Sarkar, A. Sen, K. Roy, **S. Debnath,** A. Hossain, A.Tudu, D. Ekka, M. N. Roy, Probing the Assembly of Nicotinuric Acid with Alpha and Beta Cyclodextrin Molecules by Physiochemical Investigation and Computational Approach.

Journal of Chemical, Biological and Physical Sciences, 13, 4, (2023)420-431

APPENDIX-B

LIST OF SEMINARS/CONFERENCES ATTENDED

1. National Web-Based Conference on "Environmental Determinism, Diverse Pollutions, Sources, and Controlling Management Through Sciences and Humanities" Organised by: Alipurduar University, 22nd and 23rd March 2021. ***(Presented a paper)***

2. International Seminar on "Frontiers in Chemistry **2023**" Organised by: Department of Chemistry, University of North Bengal & CRSI North Bengal Local Chapter, 13-15th March 2023. ***(Presented a poster)***

3. International Seminar on Environment, Culture and Ethnic Diversity: "Narratives from Himalayas and Sub-Himalayan Regions" Organised by: Department of Anthropology, University of North Bengal In Collaboration with IGRMS, ICSSR-ERC, ANSI, Ministry of Culture, Government of India, 15th and 16th December 2023. ***(Presented a paper)***