

THIS THESIS IS  
DEDICATED TO MY  
BELOVED PARENTS AND SISTERS

AND

MY SUPERVISOR

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

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**CERTIFICATE**

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## DECLARATION

I declare that the thesis entitled “**SYNTHESIS, CHARACTERIZATION AND INNOVATIVE APPLICATIONS OF INCLUSION COMPLEXES AND NANOCOMPOSITES OF SOME BIOLOGICALLY POTENT MOLECULES**” has been prepared by me for the degree of **Doctor of Philosophy (Ph. D.)** under the supervision of Dr. Mahendra Nath Roy, Professor, Department of Chemistry, University of North Bengal and has not formed the basis for the award of any other degree or diploma, in this or any other Institution or University.

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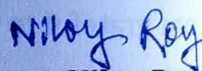
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## **PREFACE**

The research work in the thesis entitled "**SYNTHESIS, CHARACTERIZATION AND INNOVATIVE APPLICATIONS OF INCLUSION COMPLEXES AND NANOCOMPOSITES OF SOME BIOLOGICALLY POTENT MOLECULES**" was initiated for about three years before under the supervision of **Dr. Mahendra Nath Roy, Prof. of Chemistry in the Department of Chemistry, University of North Bengal.**

This work is an exertion to emphasize the supramolecular inclusion complexation of biologically active molecules and some graphene based nanocomposites to explore their physicochemical and Spectrochemical properties.

Throughout my research work, I was delighted to participate in various seminars/ symposiums/conferences in different universities as well as institutions. I was really encouraged by listening and interacting with renowned experts, reviewers and visiting Scientists. I was even lucky enough to publish the research works in international and national journals of repute, which are included in the thesis.

In carrying out with general practice of reporting scientific observation, due acknowledgement has been made whenever the work described was based on the finding of other researchers. I must take the responsibility of any unintentional oversight and errors, which might have sneaked in spite of precautions.

I am confident of surmounting challenges in my future life putting into action all the acquired knowledge and experiences all over my research period.

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## ABBREVIATIONS

CD	Cyclodextrin
$\alpha$ CD	$\alpha$ -cyclodextrin
$\beta$ CD	$\beta$ -cyclodextrin
HP- $\beta$ -CD	Hydroxy Propyl- $\beta$ -cyclodextrin
IC	Inclusion complex
TGC	Trigonelline Hydrochloride
RB	Rebamipide
NB	Nile blue
AMB	Ambroxol hydrochloride
UMB	Umbelliferone
GO	Graphene Oxide
rGO	Reduced Graphene Oxide
$\mu$ m	Micrometre
Å	Angstrom
C	Carbon
H	Hydrogen
O	Oxygen
Cm	Centimetre
CNTs	Carbon Nanotubes
DMF	Dimethylformamide
DMSO	Dimethyl sulfoxide
EtOH	Ethanol
Eq.	Equation
eV	Electron Volt
Fig.	Figure
FTIR	Fourier Transform Infrared
2D NMR	Two Dimensional Nuclear Magnetic Resonance
ROESY	Rotating Frame Overhauser Enhancement Spectroscopy
ESI-MS	Electron Ionization Spray- Mass Spectrometry
g	Gram
hrs	Hours

## ABBREVIATIONS

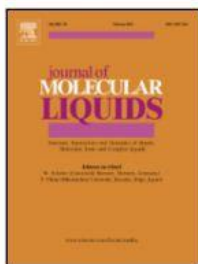
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Hz	Hertz
FTIR	Fourier Transform Infrared spectroscopy
K	Kelvin
M	Molar
m	Meter
mg	Milligram
min	Minute
mL	Millilitre
$\mu$ M	Micromolar
NIR	Near Infrared
Nm	Nanometer
$^{\circ}$ C	Degree Celsius
pH	Potential of Hydrogen
rpm	Revolutions Per Minute
SEM	Scanning Electron Microscopy
SWNT	Single Walled Carbon Nanotube
TEM	Transmission Electron Microscope
DLS	Dynamic Light Scattering
TGA	Thermogravimetric Analysis
UV-vis	Ultraviolet-visible
wt %	Weight percentage
MD	Molecular Dynamics

## APPENDIX-A

### LIST OF PUBLICATIONS/COMMUNICATION(S)

1. **N. Roy**, P. Bomzan, D. Roy, B. Ghosh and M. N. Roy, Exploring  $\beta$ -CD Grafted GO Nanocomposites with an Encapsulated Fluorescent Dye duly Optimized by Molecular Docking for Better Applications.



*Journal of Molecular Liquids, 748, (2021) 137372*

**(Included in the thesis)**

2. **N. Roy**, P. Bomzan and M. N. Roy, Probing Host-Guest inclusion complexes of Ambroxol Hydrochloride with  $\alpha$ - &  $\beta$ -Cyclodextrins by physicochemical contrivance subsequently optimized by molecular modeling simulations.



*Chemical Physics Letters, 748, (2020) 137372*

**(Included in the thesis)**

3. **N. Roy**, B. Ghosh, D. Roy, B. Bhaumik and M. N. Roy, Exploring the Inclusion Complex of a Drug (Umbelliferone) with  $\alpha$ -Cyclodextrin Optimized by Molecular Docking and Increasing Bioavailability with Minimizing the Doses in Human Body.



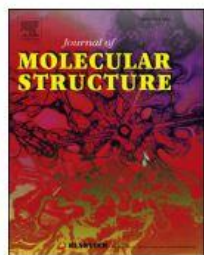
*ACS Omega, 5, 46, (2020) 30243-30251*

**(Included in the thesis)**

4. **N. Roy**, R. Ghosh, K. Das, D. Roy, T. Ghosh and M. N. Roy, Study to synthesize and characterize host-guest encapsulation of antidiabetic drug (TgC) and hydroxy propyl- $\beta$ -cyclodextrin augmenting the antidiabetic applicability in biological system.

## LIST OF PUBLICATION

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*Journal of Molecular Structure* 1179 (2019) 642-650  
**(Included in the thesis)**

5. **N. Roy**, B. Mahato, D. Roy, K. Das and M. N. Roy, Exploring inclusion complexes of cyclodextrins with quinolinone based gastro protective drug for enhancing bioavailability and sustained dischargement.



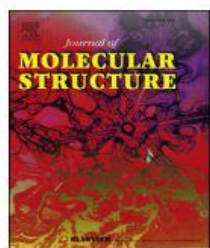
*Zeitschrift für Physikalische Chemie*, 2020, 1 (ahead-of-print)  
**(Included in the thesis)**

6. A. Yasmin, B. K. Barman, **N. Roy**, and M. N. Roy, Synthesis and Characterization of Host Guest Inclusion Complexation of Cyclic Oligosaccharide with Industrially Potent Dye in Different Phases by Physicochemical Contrivance.



*ChemistrySelect* 2020, 5, 1803 -1808

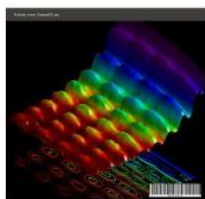
7. P. Bomzan, **N. Roy**, A. Sharma, V. Rai, S. Ghosh, A. Kumar and M. N. Roy, Molecular Encapsulation Study of Indole-3-methanol in Cyclodextrins: Effect on Antimicrobial Activity and Cytotoxicity.



*Journal of Molecular Structure* 2020, 129093

8. H. Rahaman, **N. Roy**, A. Roy, S. Ray and M. N. Roy, Exploring Existence of Host-Guest Inclusion Complex of  $\beta$ -Cyclodextrin of a Biologically Active Compound with the Manifestation of Diverse Interactions.

EMERGING SCIENCE JOURNAL



*Emerging Science Journal, 2018, 2(5), 251-260*

9. A. Dutta, **N. Roy**, K. Das, D. Roy, R. Ghosh and M. N. Roy, Synthesis and Characterization of Host Guest Inclusion Complexes of Cyclodextrin Molecules with Theophylline by Diverse Methodologies.

EMERGING SCIENCE JOURNAL



*Emerging Science Journal, 2020, 4(1), 52-72*

## APPENDIX-B

### LIST OF SEMINARS/CONFERENCES ATTENDED

1. National Seminar on “Frontiers in Chemistry – 2020” Organised by: Department of Chemistry, University of North Bengal & CRSI North Bengal Local Chapter, March 5. *(Presented a poster)*
2. SERB sponsored National Conference on “Green Chemistry: An Alternative of Conventional Chemistry” Organised by: Department of Chemistry, CBPBU, Cooch Behar, West Bengal, 20<sup>th</sup> – 21<sup>st</sup> September 2019. *(Best poster Presentation Award)*
3. National Seminar on “Frontiers in Chemistry – 2019” Organised by: Department of Chemistry, University of North Bengal & CRSI North Bengal Local Chapter. *(Presented a poster)*
4. International Seminar on “Frontiers in Chemistry 2018” Organised by: Department of Chemistry, University of North Bengal & CRSI North Bengal Local Chapter. *(Presented a poster)*
5. National Seminar on “Frontiers in Chemistry – 2017”, Funded by: University Grants Commission and SAP (DRS-III), Organised by: Department of Chemistry, University of North Bengal.
6. National Seminar on “Frontiers in Chemistry – 2016”, Funded by: University Grants Commission and SAP (DRS-III), March 07-08, Organised by: Department of Chemistry, University of North Bengal.
7. One-day seminar on “Recent Trends on Chemistry and Biology Interface”, August 28, 2015, Organised by: Chemical Research Society of India, NBU-Local Chapter, Department of Chemistry, University of North Bengal.
8. Science Academies’ Lecture Workshop on “Spectroscopy of Emerging Materials”, November 26-27, 2014, Organised by: Department of Chemistry, University of North Bengal.
9. One day Workshop on “Workshop on Crystallography”, December 9, 2014, Organised by: North Bengal Science Centre, National Council of Science Museums & Ministry of Culture Govt. of India.