SWAMI VIVEKANANDA UNIVERSITY

NEWSLETTER

SCHOOL OF BASIC SCIENCES

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MESSAGE FROM THE HOD

Dr. SUBHABRATA MONDAL
HOD and Assistant Professor
School of Basic Sciences

It gives me the greatest joy to connect with you through this edition of the four-newsletter. The School of Basic Sciences continues to uphold its commitment to academic excellence, research, and innovation. Our dedicated faculty and bright students are making remarkable strides in the various fields, contributing to the ever-expanding frontiers of knowledge. This year, we have witnessed significant accomplishments, from groundbreaking research publications to student accomplishments in national and international forums. Our department remains focused on fostering a culture of inquiry, curiosity, and collaboration, ensuring that our students receive the best foundation in the fundamental sciences. I take this opportunity to express my sincere gratitude to our faculty, researchers, and students for their unwavering dedication. Let's continue to strive for excellence and work toward making meaningful contributions to science and society.

MESSAGE FROM THE CONVENOR

Dr. KAZI HASIBUR RAHMAN
Assistant Professor
School of Basic Sciences

The School of Basic Sciences is committed to fostering a culture of curiosity, innovation, and academic excellence. As we embark on another exciting semester, I encourage everyone to explore the wonders of science, collaborate across disciplines, and push the boundaries of knowledge. Let's make the most of the opportunities ahead, whether in the lab, classroom, or beyond. Together, we can achieve remarkable milestones and contribute meaningfully to the scientific community. Wishing you all a productive and inspiring term ahead!

Editor's Note

TEACHER EDITOR'S

We would like to express our gratitude to the HOD Sir, senior teachers, editorial team members, and article contributors for their contributions to the newsletter's third edition in 2025. This newsletter's content includes fascinating articles and the most recent scientific advancements. Being a member of the editorial team is an excellent experience for us. Students are encouraged to develop an engrossing interest in science by this newsletter.

Dr. Sagar Chakraborty

Assistant Professor
School of Basic Sciences

Mr. Tanmoy Pal

Assistant Professor
School of Basic Sciences

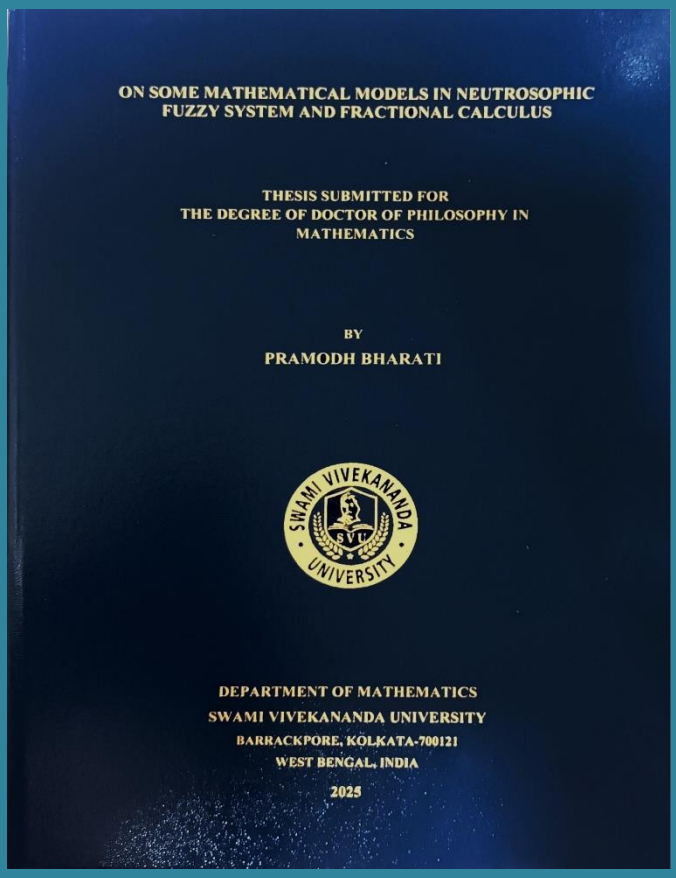
Dr. Shilpa Maity

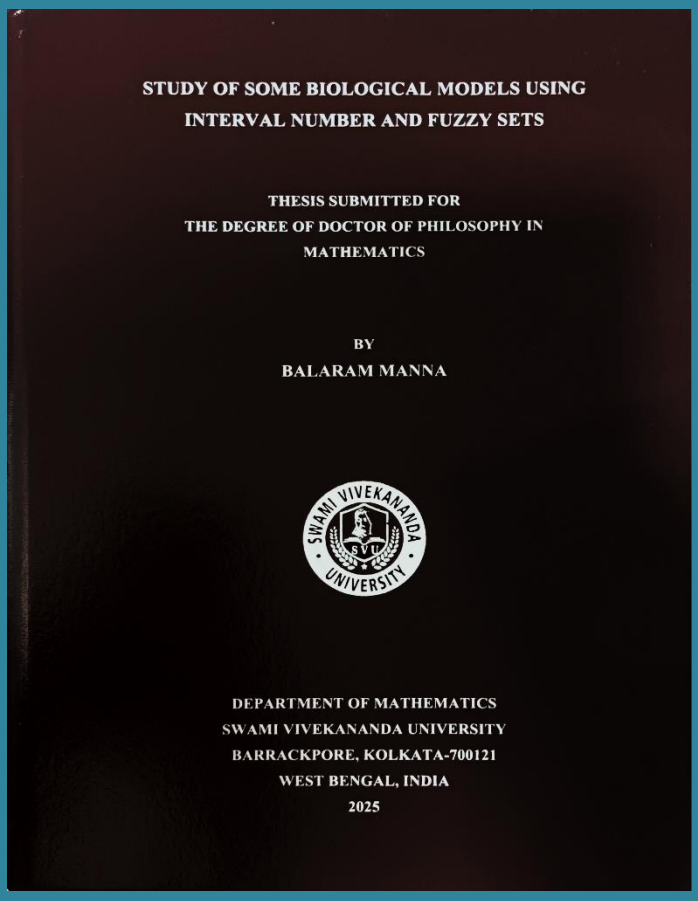
Assistant Professor
School of Basic Sciences

Events

Thesis Submitted in Department of Mathematics

2025





Thesis Submitted by Mr. Balaram Manna and Mr. Pramodh Bharati from Department of Mathematics, under the supervision of Dr. Subhabrata Mondal.

Seminar on Insights of Binary Star

26th June, 2025

Articles

WRITE-UPS THAT INSPIRE

Journal Article

In situ NADH regeneration coupled to enzymatic CO2 reduction: From fundamental concepts to recent advances

Journal of Environmental Chemical Engineering 13 (2025) 116657

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In situ NADH regeneration coupled to enzymatic CO_2 reduction: From fundamental concepts to recent advances

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ABSTRACT

Biocatalytic CO_2 reduction using enzymes is among the most effective methods for producing hydrocarbon fuels from CO_2 with high selectivity. Many of these enzymes rely stoichiometrically on the NADH cofactor to provide the necessary reducing equivalents. However, the high cost and significant demand for the cofactor hinder the industrial feasibility of this method. NADH regeneration allows for the recycling of NADH at catalytic concentrations, thereby eliminating the stoichiometric requirement. Consequently, biocatalytic CO_2 reduction should be viewed as a two-part cooperative process involving an NADH regenerating unit and an enzymatic CO_2 reducing unit. This comprehensive review outlines the concepts and mechanisms underlying NADH regeneration and CO_2 reduction. In the first part of the review, various methods of NADH regeneration and related research are discussed. The second part addresses the basic concepts regarding enzymatic CO_2 reduction, followed by a review of research on CO_2 reduction coupled with NADH regeneration. This includes a review of single-and multi-enzyme cascade systems for the production of primarily three products: formate, formaldehyde, and methanol. Various strategies to maximize the synergy between the two units and maintain their stability, such as compartmentalization, immobilization, and encapsulation of the multiple enzyme partners, are examined. Toward the end, nature-inspired artificial photosynthetic systems are discussed. These systems facilitate the conversion of solar energy into fuels through CO_2 reduction, the carbon source, and water splitting, the electron source. This review highlights the advancements and challenges in the field of biocatalyzed CO_2 reduction, particularly concerning hybrid cofactor utilization systems.

1. Introduction

Global greenhouse gas (GHG) emissions have been on the rise and more so in the recent past. CO_2 emissions from fossil fuel burning and other industrial and human activities dominate GHG emissions. According to the latest emissions gap report 2024, 2023 saw the highest ever CO_2 emission (57.4 gigatons of CO_2 equivalent). Immediate actions are needed for the substantial mitigation of anthropogenic CO_2 to keep the global temperature rise in the range of 1.5 – 2 °C for the next decade. As such, the mitigation of this anthropogenic CO_2 is approached in three ways; the first is cutting back reliance on fossil fuel burning for fulfilling energy demands and transitioning towards carbon emissions-free perennial sources of energy. The second is to increase the sinks for long-term storage of emitted CO_2 i.e., carbon capture and storage (CCS), and finally use CO_2 as feedstocks for the generation of fine chemicals and fuels i.e., carbon capture and utilization (CCU). Under CCS, CO_2 is collected from exhaust sources, separated from flue gases, and transported via pipelines to be stored under natural sites like underground/geological cavities, depths of ocean floors, etc [1]. However the process of carbon capture and separation is expensive, and the transportation is preluded with problems due to the possibilities of leakage or formation of corrosive carbonic acid [2]. The case of CCU is rather attractive compared to CCS as the waste CO_2 is transformed to hydrocarbon fuels and fine chemicals making it commercially advantageous and green so long as pollution-free renewable energy sources are used to provide energy for the conversion.

CO_2 utilization reactions generally fall under two categories based on the products obtained: (1) fixation reactions like carboxylation wherein

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[1] United Nations Environment Programme (2024). Emissions Gap Report 2024: Broken Record – Temperatures hit new highs, yet world fails to cut emissions (again). Nairobi. https://doi.org/10.59117/20.500.11822/46404.

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DESCRIPTION

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