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 SIXTH 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

MEMORIE'S

# Ph.D. Viva-Voce Examination
# in
# Department of Mathematics

07/ 11/ 2025

Ph.D. Viva-Voce Examination of Mr. Pramodh Bharati in Department of Mathematics under the supervision of Dr. Subhabrata Mondal.

# BLOOD DONATION CAMP

## 12/ 11/ 2025

# Articles

## Write-ups That Inspire

# Journal Article

## FOURTH-ORDER NONLINEAR SCHRÖDINGER EQUATION FOR APPLICATION TO CAPILLARY-GRAVITY WAVES IN DEEP WATER ON FLOWS OF BULK VORTICITY

FOURTH-ORDER NONLINEAR SCHRÖDINGER EQUATION FOR APPLICATION TO CAPILLARY-GRAVITY WAVES IN DEEP WATER ON FLOWS OF BULK VORTICITY

DEBRAJ GIRI[1], TANMOY PAL[2] and ASOKE KUMAR DHAR[1]

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Abstract

The modulational instability of weakly nonlinear capillary-gravity waves (CGWs) on the surface of infinitely deep water with uniform vorticity background shear is examined. Assuming a narrow band of waves, the fourth-order nonlinear Schrödinger equation (NSE) is derived from Zakharov's integral equation (ZIE). The analysis is restricted to one horizontal dimension, parallel to the direction along the wave propagation to take advantage of a formulation using potential flow theory. It is to be noted that the dominant new effect introduced to the fourth order is the wave-induced mean flow response. The key point of this paper is that the present fourth-order analysis shows considerable deviation in the stability properties of CGWs from the third-order analysis and gives better results consistent with the exact results. It is found that the growth rate of instability increases for negative vorticity and decreases for positive vorticity, and the effect of capillarity is to reduce the growth rate of instability. Additionally, the effect of vorticity on the Peregrine breather, which can be considered as a prototype for freak waves, is investigated.

2020 *Mathematics subject classification*: primary 76B07; secondary 76B15, 76B45.

*Keywords and phrases*: fourth-order nonlinear Schrödinger equation, bulk vorticity, capillary-gravity waves, stability analysis.

1. Introduction

In general, capillary-gravity waves (CGWs) are formed due to the presence of wind which generates a shear flow in the uppermost layer of the water and so these waves propagate with vorticity. In recent years, there has been a renewed interest in periodic waves in the presence of vorticity. Generally, in ocean and coastal waters, the velocity profiles are produced by bottom friction and surface wind stress, and so they are

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## DESCRIPTION

The modulational instability of weakly nonlinear capillary-gravity waves (CGWs) on the surface of infinitely deep water with uniform vorticity background shear is examined. Assuming a narrow band of waves, the fourth-order nonlinear Schrödinger equation (NSE) is derived from Zakharov's integral equation (ZIE). The analysis is restricted to one horizontal dimension, parallel to the direction along the wave propagation to take advantage of a formulation using potential flow theory. It is to be noted that the dominant new effect introduced to the fourth order is the wave-induced mean flow response..