Title: Fundamental Analysis of Fluid Flow and Heat Transfer in Ferrofluid Systems

Mansi Mehta[1] and Anupam Bhandari[2]
[1, 2]Department of Mathematics, Applied Science Cluster, School of Advanced Engineering, UPES, Energy Acres Building, Bidholi, Dehradun- 248007, Uttarakhand, India.
[1]Email: mansimehta36@gmail.com ; [2]Email: pankaj.anupam6@gmail.com

Abstract: Ferrofluids, colloidal suspensions of magnetic nanoparticles, have gained attention due to their unique properties and potential applications in various fields, including biomedicine. This study focuses on the fundamental aspects of fluid flow and heat transfer in ferrofluid systems, providing a basic understanding necessary for advanced applications. We present a basic mathematical model that integrates the Navier-Stokes equations with energy equations to describe the behaviour of ferrofluids under different conditions. The model is simplified using similarity transformation, which aids in the identification of key factors influencing fluid dynamics and heat transfer efficiency. The transformed equations are numerically solved using MATLAB to visualize flow patterns and temperature distribution. The results offer insights into the basic principles governing ferrofluid behaviour, highlighting the effects of magnetic field strength and thermal gradients. This fundamental analysis serves as a stepping stone for more complex studies, contributing to the broader understanding of ferrofluid applications in various engineering and biomedical contexts.

Keywords: Ferrofluids, Fluid Dynamics, Heat Transfer, Mathematical Modelling, Magnetic Fields.