SPECIAL ISSUE ORIGINAL STUDY

Elli's Liquid Flow in a Wavy Channel with Slip Effect, Wall Properties, and Heat Transfer

Devaki Palluru*, Yatin Sood

Department of Mathematics, Sri Venkateswara College, University of Delhi, New Delhi, India

Abstract

The dual behavior of Elli's fluid motivated us to work on it. The fluid behaves as both Newtonian/non-Newtonian based on the low and high shear rates, respectively. The paper focused on the flow of Ellis fluid in a peristaltic channel with wall properties and heat transfer. The channel is symmetric in nature, and slip conditions are considered near the elastic walls. The governing equations of the flow are solved analytically using suitable boundary conditions, which yield velocity and temperature functions. The novelty of the paper is to analyze the nature of Newtonian/non-Newtonian fluids under the same conditions so that future researchers can use this fluid to analyze different critical parameters and predict the outcome of both Newtonian and non-Newtonian behaviors. Also, there is no work done on Elli's fluid in a nonuniform channel in the presence of wall properties, which is very much close to the flow of blood in arteries. The behavior of velocity and temperature is observed through graphs by different physical parameters. As the viscous damming forces increase, there is a decrease in the velocity of the fluid flow, and the temperature effect also decreases. This is due to the fluid behavior in a wavy channel. There are many interesting facts that are discussed in the paper in detail. The results will motivate us to concentrate on many observations of blood flow under different physical situations.

Keywords: Elli's liquid, Heat transfer, Slip effect, Stream function, Wall properties, Wavy channel

1. Introduction

In biological systems, the transportation of several substances is primarily facilitated by a process called peristalsis. It follows the rhythmic compression and relaxation of arteries and veins, forming a wavy channel to facilitate the movement of body fluids. In humans, peristalsis can be readily observed in the transfer of food from the mouth to the stomach through the esophagus and in the transit of urinary fluids from the renal systems to the urinary bladder via the ureters. This phenomenon has developed a substantial field of study because of its applications in various dynamical classifications. Research by Prasad *et al.* (2024) highlighted the sensitivity of Ellis fluid velocity profiles to magnetic field intensity and slip conditions, demonstrating that these parameters are critical for optimizing pumping efficiency in homogeneous channels. Ayub *et al.* (2025) investigated mixed convective peristaltic flow of Xanthan gum fluid in a twisted channel, showing pronounced effects of magnetic fields and channel curvature on heat conduction rates. The analysis of peristaltic inflow of Williamson fluid on a rough wall was done by Tanveer *et al.* (2024), highlighting that surface roughness and nanoparticle inclusion can alter flow resistance and improve mixing efficiency in wavy channels.

Tanveer *et al.* (2024) showed that higher magnetic field intensity and heat transfer parameters increase entropy generation and have notable impacts on overall thermodynamic irreversibility. Kanwal *et al.* (2024) analyzed a wavy channel with varying density and magnetic field, revealing that both thermal conductivity and particle distribution variations can increase or decrease heat transport

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* Corresponding author.
E-mail address: p.devaki@svc.ac.in (D. Palluru).

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