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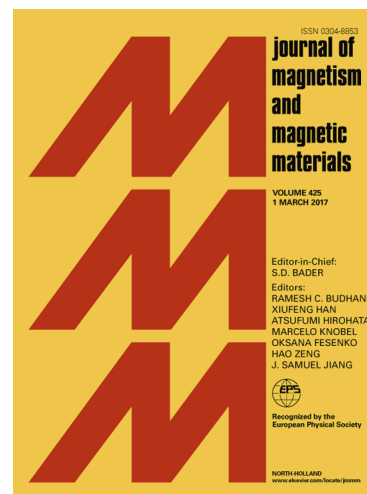
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Flow of Magnetic Particles in Blood with Isothermal Heating: A Fractional Model for Two-Phase Flow

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Abstract

In the sixteenth century, medical specialists were of the conclusion that magnet can be utilized for the treatment or wipe out the illnesses from the body. On this basis, the research on magnet advances day by day for the treatment of different types of diseases in mankind. This study aims to investigate the effect of magnetic field and their applications in human body specifically in blood. Blood is a non-Newtonian fluid because its viscosity depends strongly on the fraction of volume occupied by red cells also called the hematocrit. Therefore, in this paper blood is considered as an example of non-Newtonian Casson fluid. The blood flow is considered in a vertical cylinder together with heat transfer due to mixed convection caused by buoyancy force and the external pressure gradient. Effect of magnetic field on the velocities of blood and magnetic particles is also considered. The problem is modelled using the Caputo-Fabrizio derivative approach. The governing fractional partial differential equations are solved using Laplace and Hankel transformation techniques and exact solutions are obtained. Effects of different parameters such as Grashof number, Prandtl number, Casson fluid parameter and fractional parameters, and magnetic field are shown graphically. Both velocity profiles increase with the increase of Grashoff number and Casson fluid parameter and reduce with the increase of magnetic field.

Keywords: Magnetic particles; Casson fluid; Blood flow; Heat transfer; Fractional derivatives.

1. INTRODUCTION

Biomagnetic fluid dynamics (BFD) is a new area of research which examines the fluid flow under the action of the magnetic field. The interest regarding the Biomagnetic fluids, specifically in bio-engineering has excessive importance due to the major applications such as Magnetic drug targeting [1], magnetic devices for cell separation [2], adjusting blood flow during the surgery and transporting complex bio-waste fluids [3],

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