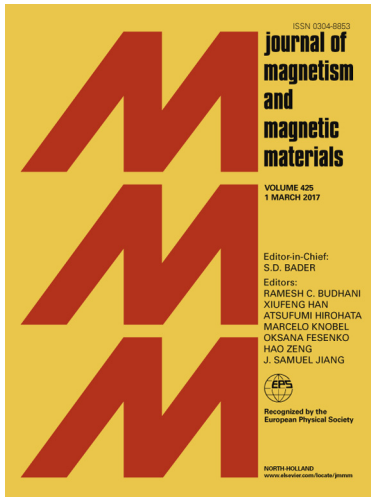

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Analysis of blood flow with nanoparticles induced by uniform magnetic field through a circular cylinder with fractional Caputo derivatives

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Abstract

The magneto hydrodynamic blood flow in the presence of magnetic particles through a circular cylinder is investigated. To calculate the impact of externally applied uniform magnetic field, the blood is electrically charged. Initially the fluid and circular cylinder is at rest but at time $t = 0^+$, the cylinder starts to oscillate along its axis with velocity $f \sin(\Omega t)$. To obtain the mathematical model of blood flow with fractional derivatives Caputo fractional operator is employed. The solutions for the velocities of blood and magnetic particles are procured semi analytically by using Laplace transformation method. The inverse Laplace transform has been calculated numerically by using MATHCAD computer software. The obtained results of velocities are presented in Laplace domain in terms of modified Bessel function $I_0(\cdot)$. The obtained results satisfied all imposed initial and boundary conditions. The hybrid technique that is employed here less computational effort and time cost as compared to other techniques used in literature. As the limiting cases of our results the solutions of the flow model with ordinary derivatives has been procured. Finally, the impact of Reynolds number Re, fractional parameter α and Hartmann number Ha is analyzed and portrayed through graphs. It is worthy to pointing out that fractional derivatives brings remarkable differences as compared to ordinary derivatives. It also has been observed that velocity of blood and magnetic particles is weaker under the effect of transverse magnetic field.