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Numerical Solution of Magneto-Hydrodynamic Flow of a Viscous Fluid in the Presence of Nanoparticles with Fractional Derivatives through a Cylindrical Tube

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Abstract : Biomagnetic fluids like blood play key role in different applications of medical science and bioengineering. In this paper, the magnetohydrodynamic flow of a viscous fluid with magnetic particles through a cylindrical tube is investigated. The fluid is electrically charged in the presence of a uniform external magnetic field. The movement in the fluid is produced due to the cylindrical tube. Initially, the fluid and tube are at rest and at time $t=0^{+}$, the tube starts to move along its axis. To obtain the mathematical model of flow with fractional derivatives fractional calculus approach is used. The solution of the flow model is obtained by using Laplace transformation. The Simon's numerical algorithm is employed to obtain inverse Laplace transform. The hybrid technique, we are employing has less computational effort as compared to other methods. The numerical calculations have been performed with Mathcad software. As the special cases of our problem, the solution of flow model with ordinary derivatives and flow without magnetic particles has been procured. Finally, the impact of non-integer fractional parameter alpha, Hartmann number Ha, and Reynolds number Re on flow and magnetic particles velocity is analyzed and depicted by graphs.

Keywords : viscous fluid, magnetic particles, fractional calculus, laplace transformation
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