Magnetohydrodynamic rotating flow and heat transfer of ferrofluid due to an exponentially permeable stretching/shrinking sheet

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ABSTRACT

This study accentuates the magnetohydrodynamic effect on three dimensional rotating flow and heat transfer of ferrofluid over an exponentially permeable stretching/shrinking sheet with suction effect. The flow and heat transfer model in partial differential equations are simplified by employing the suitable similarity transformations to a system of ordinary differential equations. Numerical results are generated by using the Matlab solver bvp4c function. The computational outcomes give significant insight into the rotating flow. The influence of three different types of base fluids are also considered, namely water, methanol and kerosene. The skin friction coefficients and the rate of heat transfer are prominently affected by the intensity of suction, magnetic field, rotating scale, concentration of nanoparticles and Prandtl number. It is found that a rise in the rotation parameter causes the ferrofluid to exert a drag force on the surface of the shrinking sheet. High intensity of the magnetic field induces higher Lorentz force and leads to the increment of the skin friction. A large concentration of nanoparticles degenerates the rate of heat transfer. On the other hand, the presence of dual solutions within the shrinking region is observed for certain values of the governing parameters. The execution of stability analysis affirms the reliability and stability of the first solution while the second solution is unstable.

KEYWORDS:

Ferrofluid; Magnetohydrodynamic; Rotating flow; Dual solutions; Stability analysis