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Al_2O_3 Nano-Fluid Flow and Heat Transfer near an infinite Rotating Porous Disk in the presence of Magnetic Field

S. Salman Nourazar[1], Roozbeh Saghatchi[2*], Golchehreh Bayat[3]

[1]Professor, Department of Mechanical Engineering, Amirkabir University of Technology. Email: icp@aut.ac.ir
[2]PhD student, Department of Mechanical Engineering, Amirkabir University of Technology. Email: r.saghatchi@aut.ac.ir
[3]BSc, Department of Chemistry, Faculty of Sciences, Zanjan Branch, Islamic Azad University. Email: golchehreh.bayat@gmail.com

[*]Corresponding author Tel.: +98-21-64543451

Abstract

This paper studied the effect of an axial magnetic field on the nano-fluid flow and heat transfer consisting of aluminum oxide Al_2O_3 nano-particles with water base-fluid above a porous rotating disk. Numerical solution of the nonlinear governing equations including continuity, momentum and energy equations is obtained. In order to overcome this task, the governing partial differential equations with the corresponding boundary conditions have been simplified using a similarity solution to the system of ordinary differential equations with the appropriate boundary conditions which were solved using a shooting method with fourth-order Runge-Kutta algorithm. The effects of magnetic field strengths on the flow and heat transfer parameters have been fully considered. It is seen that the magnetic field has suppressible effect on the velocity field and heat transfer. Larger magnetic field strength causes a smaller Nusselt number and radial skin coefficient, but larger tangential skin friction coefficient. Effects of volume fraction of nano-particles, injection (suction) velocity have been also considered. It is also seen that the effect of magnetic field for larger values of volume fractions become more significant.

Keyword: nano-fluid, porous rotating disk, similarity solution, Runge-Kutta method.