Magnetohydrodynamic boundary layer flow and heat transfer of nanofluids past a bidirectional exponential permeable stretching/shrinking sheet with viscous dissipation effect

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ABSTRACT

The problem of boundary layer flow and heat transfer of magnetohydrodynamic (MHD) nanofluids which consist of Fe_3O_4, Cu, Al_2O_3, and TiO_2 nanoparticles and water as the base fluid past a bidirectional exponentially permeable stretching/shrinking sheet is studied numerically. The mathematical model of the nanofluid incorporates the effect of viscous dissipation in the energy equation. By employing a suitable similarity transformation, the conservative equations for mass, momentum, and energy are transformed into the ordinary differential equations. These equations are then numerically solved with the utilization of bvp4c function in MATLAB. The effects of the suction parameter, magnetic parameter, nanoparticle volume fraction parameter, Eckert number, Prandtl number, and temperature exponent parameter to the reduced skin friction coefficient as well as the local Nusselt number are graphically presented. Cu is found to be prominently good in the thermal conductivity. Nevertheless, higher concentration of nanoparticles leads to the deterioration of heat transfer rate. The present result negates the previous literature on thermal conductivity enhancement with the implementation of nanofluid. Stability analysis is conducted since dual solutions exist in this study, and conclusively, the first solution is found to be stable.

KEYWORDS

Dual solutions; Magnetohydrodynamic; Nanofluid; Stability analysis; Viscous dissipation

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