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Research Article

Effects of Slip and Heat Generation/Absorption on MHD Mixed Convection Flow of a Micropolar Fluid over a Heated Stretching Surface

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A theoretical analysis is performed to study the flow and heat transfer characteristics of magnetohydrodynamic mixed convection flow of a micropolar fluid past a stretching surface with slip velocity at the surface and heat generation (absorption). The transformed equations solved numerically using the Chebyshev spectral method. Numerical results for the velocity, the angular velocity, and the temperature for various values of different parameters are illustrated graphically. Also, the effects of various parameters on the local skin-friction coefficient and the local Nusselt number are given in tabular form and discussed. The results show that the mixed convection parameter has the effect of enhancing both the velocity and the local Nusselt number and suppressing both the local skin-friction coefficient and the temperature. It is found that local skin-friction coefficient increases while the local Nusselt number decreases as the magnetic parameter increases. The results show also that increasing the heat generation parameter leads to a rise in both the velocity and the temperature and a fall in the local skin-friction coefficient and the local Nusselt number. Furthermore, it is shown that the local skin-friction coefficient and the local Nusselt number decrease when the slip parameter increases.

1. Introduction

Micropolar fluids are those with microstructure belonging to a class of complex fluids with nonsymmetrical stress tensor, and usually referred to as micromorphic fluids. Physically they represent fluids consisting of randomly oriented particles suspended in a viscous medium. The theory of micropolar fluid was first introduced and formulated by Eringen [1]. Later Eringen [2] generalized the theory to incorporate thermal effects in the so-called thermo-micropolar fluid. The theory of micropolar fluids is expected to provide a mathematical model for the non-Newtonian behavior observed in certain fluids such as liquid crystal [3, 4], low-concentration suspension flow [5, 6], blood rheology [7–10], the presence of dust or smoke [11, 12], and the effect of dirt in journal bearing [13–16].