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Basic topics: Fundamental Physics

Combined effect of viscous dissipation and Joule heating on MHD flow and heat transfer of a micropolar fluid over a stretching surface with variable surface heat flux

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Summary. — The combined effect of viscous dissipation and Joule heating on the flow and heat transfer of an electrically conducting micropolar fluid over a stretching surface with variable wall heat flux in the presence of heat generation/absorption is investigated. The local similarity solutions of the transformed equations describing the problem are solved numerically. The effects of various physical parameters on the flow, micro-rotation and temperature profiles are presented graphically. The numerical results of the local skin-friction coefficient and the local Nusselt number are given in a tabular form then discussed.

PACS 47.50.-d – Non-Newtonian fluid flows.
PACS 44.20.+b – Boundary layer heat flow.

1. – Introduction

During the last few years, the study of micropolar fluids has gained considerable attention due to its many practical applications. These applications include polymeric fluids, real fluids with suspensions, liquid crystal, animal blood and exotic lubricants. The theory of micropolar and thermomicropolar fluids was introduced by Eringen [1, 2]. The micropolar fluid theory has been applied extensively for studying many complicated fluid motions [3-13]. On the other hand, the study of magnetohydrodynamic flow of an electrically conducting fluid over a stretching sheet has gained considerable interest because of its applications in industry. For example in the extrusion of a polymer sheet from a die, the sheet is sometimes stretched. During this process, the properties of the final products depend considerably on the rate of cooling. By drawing such sheet in an electrically conducting fluid subjected to a magnetic field, the rate of cooling can be controlled and the final product can be obtained with desired characteristics. Crane [14] presented an exact similarity solution in closed analytical form for the laminar boundary

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