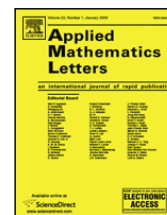




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# Flow of a second grade fluid over a sheet stretching with arbitrary velocities subject to a transverse magnetic field

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## ABSTRACT

The boundary layer flow of a second grade fluid over a permeable stretching surface with arbitrary velocity and appropriate wall transpiration is investigated. The fluid is electrically conducting in the presence of a constant applied magnetic field. An exact solution to the nonlinear flow problem is presented.

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## 1. Introduction

Interest in the boundary layer flows over a stretching surface has increased substantially during the last few years due to its several industrial applications. Extensive research on this topic has been undertaken since the pioneering work of Sakiadis [1] (flow over a uniformly moving continuous surface). Crane [2] obtained an exact analytical solution for the boundary layer flow when the stretching velocity is proportional to the distance from the origin. For more details, we refer the papers [3–9] and various references given therein. Each of these is observed for specific wall stretching velocity. Weidman and Magyari [10] are the first to find an exact solution for the viscous flow induced by the arbitrary stretching sheet. The analysis of [10] is extended to a micropolar fluid by Magyari and Kumaran [11]. Fang and Zhong [12] considered the viscous flow over a shrinking surface with arbitrary velocity.

In this note, we construct the exact solution for the flow of a non-Newtonian fluid over a stretching surface with arbitrary velocity and appropriate wall transpiration. The solution for arbitrary stretching velocity is systematically built (as in [10]) with the help of linear, quadratic and polynomial stretchings. Mathematical formulation of the problem is based on the constitutive equation of the second grade fluid. Generalized expressions for velocity field and skin friction are obtained. Variations of the embedded flow parameters are discussed and significant observations are presented in the concluding section.

## 2. Generalized stretching solution

The non-dimensional boundary layer equations for the flow of a second grade fluid over a stretching sheet subject to a transverse magnetic field with appropriate boundary conditions are

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0, \quad (1)$$

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