IMPACT OF HEAT AND MASS TRANSFER ON THE UNSTEADY SQUEEZING FLOW OF A NANOFLUID WITH MULTIPLE CONVECTIVE CONDITIONS

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Abstract

In this study, the effect of multiple convective conditions on a viscous unsteady incompressible electrically conductive nanofluid is analyzed. In addition, the fluid is squeezed between two parallel plates in the presence of an applied magnetic field. Nonlinear partial differential equations are remodelled into ordinary ones by introducing similarity transformations, which are solved numerically using the shooting iteration technique together with the Runge–Kutta sixth-order integration scheme; after that, the impact of affined parameters on the temperature and velocity distribution is shown by means of tables and graphs. Our studies suggest that the fluid temperature and the heat transfer rate decrease with the squeeze parameter.

1. Introduction

Studies of heat and mass transfer of a viscous liquid in squeezing drift are important not only for chemical/mechanical engineering (polymer processing, compressing, chemical material loading, and chocolate filtering) but also for our every day life's relevancy. The first study in this context was conducted by Stefan [1]. Mahmood et al. [2] numerically depicted the squeezed Newtonian flow over a porous surface. An axisymmetric and 2D squeezing drift was exhibited by Rashid et al. [3]. Siddiqui et al. [4] addressed the squeezing flow of a magnetic hydrodynamic fluid between infinite parallel plates. Domairry and Aziz [5] analytically extracted a solution for the squeezing flow of a viscous fluid between two parallel disks with blowing. Later, the above work was extended by Hayat et al. [6] to analyze second-grade fluids. Mustafa [7] revealed the squeezing flow of an unsteady viscous liquid. In the presence of Brownian motion, Sheikholeslami et al. [8] analytically (DTM) studied the flow characteristics of a nanofluid drift between two parallel plates. The literature that spotlighted these achievements can be traversed in [9–12].

In the boundary layer drift scenario, two types of conditions—specified surface temperature and specified surface heat flux—are commonly used. It takes place when a linear correlation exists between the surface temperature and the surface heat transfer. Usually, under conditions of Newtonian heating, which is well known as a conjugate convection flow, heat is issued to the convective fluid via the boundary layer with a finite heat capacity. This phenomenon in heat transport rate depends on the local difference in the temperature with the ambient situations. This transcendent aspect of Newtonian heating occurs in many vital engineering devices, such as heat exchanger devices. Relevant studies regarding convective boundary conditions were conducted in [13–16]. Aziz and Khan [17], Das et al. [18], Uddin et al. [19] discussed the convective boundary layer flow of a nanofluid over a convectively heated