

Abstract

This thesis is dedicated to some analytical studies regarding motions of Newtonian and non-Newtonian fluids in different circumstances. We use classical computational techniques capable of accurately operating in order to obtain exact analytical solutions. Some basic definitions and concepts regarding fluid motion and methods to solve the flow problems have been discussed.

Our aim is to furnish some results regarding the unsteady magnetohydrodynamic (MHD) natural convection flow with Newtonian heating and constant mass diffusion over an infinite vertical plate. Radiative effects are taken into consideration and exact solutions are established under Boussinesq approximation.

Moreover, our studies include Couette flows of Oldroyd-B fluids between two infinite coaxial circular cylinders. The motion is generated by the outer cylinder that is moving along its axis with an arbitrary time-dependent velocity. Three special cases, namely uniform translation of the cylinder, Ramp-type translation of the cylinder, and oscillating translation of the cylinder, are considered.

Furthermore, our aim is to establish some results regarding the unsteady motions of Oldroyd-B fluids over an infinite plate. The motion of the fluid is induced due to the plate that applies an arbitrary time-dependent shear stress to the fluid.

Extending our studies, we establish the exact solutions for the motion of an Oldroyd-B fluid induced by an infinite circular cylinder that applies a constant rotational shear stress to the fluid.

In all flow models, we obtained solutions for motions with technical relevance,

both the velocity field and for the shear stresses. These solutions can easily be particularized to give the similar solutions corresponding to Maxwell, second grade and Newtonian fluids performing the same motions. To get some physical insight for the present models, some special cases with engineering applications are considered and different results from the literature are recovered. The exact analytical solutions that have been presented in all the fluid flow models satisfy all imposed initial and boundary conditions. Finally, the influence of material parameters on the velocity and shear stress distribution is graphically illustrated.