Abstract

This thesis deals with the unsteady flow behavior of some rate type fluids under different circumstances with fractional derivatives. Firstly, some basic definitions and concepts regarding the fluid motion and methods to solve the flow problems have been discussed. Then the motion of ordinary Maxwell fluid are generalized by using an integro-differential and that of Oldroyd-B fluids with fractional derivatives between two parallel walls perpendicular to a plate is studied.

In **chapter 2**, we analyze the unsteady unidirectional flow of a Maxwell fluid with time-dependent viscosity modeled by means of the fractional calculus. The classical equations corresponding to the flow of a Maxwell fluid are generalized by using an integro-differential term which introduces memory formalism. Analytical solutions of two initial-boundary value problems namely, flows in unbounded domains and Couette flow, are determined by means of Laplace and Fourier transforms. These solutions are expressed by means of Mittag-Leffler and G-Lorenzo-Hartley functions. Some useful relationships between these functions are provided. A particular case of Couette flow is studied and the influence of fractional parameter on the fluid behavior is also analyzed.

In chapter 3, we present some new exact solutions corresponding to oscillating flows of MHD Oldroyd-B fluid with fractional derivative. Exact solutions for the oscillating motion of the fractional MHD Oldroyd-B fluid due to sine oscillation of an infinite plate between two sides walls are established with the help of integral transforms. The expressions for the velocity and shear stress that have been obtained satisfy all imposed initial and boundary conditions.