Abstract

This work presents new results regarding the behavior of some non-Newtonian fluids into different circumstances. After some preliminaries regarding constitutive equations, motion equations and integral transforms, new exact solutions for the velocity field and the shear stress corresponding to some flows with technical relevance have been established for ordinary second grade, Oldroyd-B fluids and generalized Maxwell fluids. Just as in the case of Navier-Stokes fluids, it is necessary to develop a large class of exact and approximate solutions, they serving as tests to verify numerical schemes that are developed to study complex unsteady flow problems.

In chapter 2, by means of the Laplace transform, there are established new exact solutions corresponding to the first problem of Stokes for Oldroyd-B fluids. These solutions, in accordance with the previous results obtained using Fourier sine transform, can be easily specialized to give similar solutions for Maxwell fluids. The main aim of chapter 3 was to solve a very important problem, namely to determine the required time to reach the steady-state for the second problem of Stokes corresponding to second grade fluids. In addition to solve this problem we also found new exact solutions for this problem. Our solutions, unlike the solutions obtained by Erdogan for Newtonian fluids, are written as a sum between steady state and transient solutions.

Chapter 4 contains exact solutions for the unsteady flow of an Oldroyd-B fluid between two side walls perpendicular to a plate. In the absence of side walls the obtained solutions tend to the similar solutions for the flow over a flat plate (the first problem of Stokes). The influence of the pertinent parameters on the velocity of the fluid at the middle of the channel as well as on the shear stress on the bottom is

underlined by graphical illustrations. In chapter 5, by means of Laplace and Hankel transforms, we obtained the solutions for unsteady flow of a generalized Maxwell fluid between two circular cylinders. These solutions, presented as a sum of the Newtonian solutions and the non-Newtonian contributions, can be easily specialized to give the similar solutions for ordinary Maxwell fluids. Finally, the influence of the pertinent parameters on the velocity of the fluid are also underlined by graphical illustrations.