Abstract

The present PhD dissertation has completed research on results related to flow behavior due to shear stress on the boundary of some Newtonian and non-Newtonian fluids under different circumstances. Firstly, we have discussed some concepts related to Newtonian and non-Newtonian fluids, constitutive equations, equations of motion and integral transforms. Secondly, we have presented the exact solutions of velocity, temperature and shear stress fields corresponding to some flows of Newtonian, second grade, Maxwell and Oldroyd-B fluids.

We have established general solutions for the unsteady free convection flow of an incompressible viscous fluid due to an infinite vertical plate that applies a shear stress $f(t)$ to the fluid, when thermal radiation and porous effects are considered. These general solutions may generate a large class of exact solutions corresponding to different motions with technical relevance. Some special cases are investigated under the effects of pertinent parameters on the fluid motion.

Unsteady motion of second grade fluids induced by an infinite plate that applies a time-dependent shear stress $f(t)$ to the fluid is also studied. General solutions may be reduced to new solutions of Newtonian fluids or they may be used to obtain known solutions from the literature. Furthermore, in view of an important remark, general solutions for the flow due to a moving plate may be developed.

We have also studied the Couette flows of a Maxwell fluid caused by the bottom plate applying shear stress on the fluid. Exact expressions for velocity and shear stress corresponding to the fluid motion are determined using the Laplace transform. Two particular cases with constant shear stress on the bottom plate or sinusoidal oscillations of the wall shear stress are further discussed. Some important characteristics of fluid motion are highlighted through graphs.

The unsteady motion of an Oldroyd-B fluid over an infinite flat plate is studied by means of the Laplace and Fourier transforms. After time $t = 0$, the plate applies cosine/sine oscillating shear stress to the fluid. The solutions obtained are presented

as a sum of steady-state and transient solutions, which may easily be reduced to the similar solutions corresponding to Newtonian or Maxwell fluids. A central issue namely, obtaining the time for which the steady-state is reached is address by means of numerical calculations and graphical illustrations.

The influence of oscillations frequency or of material parameters on this time corresponding to the steady-state is also analyzed. It is lower for cosine oscillations in comparison to sine oscillations of the shear, decreases with respect to ω and λ and increases with regard to λ_r.