ABSTRACT

The non-Newtonian fluids are of vital importance due to their diverse applications in modern technology, industries and bio-mechanics. Thus, the analysis of thermal stability and thermoosmotic stability of such fluids like Rivlin-Ericksen fluids, couple-stress fluids, ferromagnetic fluids and micropolar fluids are desirable. We have used the two fundamental hypotheses i.e., continuum hypothesis and Newtonian mechanics throughout our study. In the present thesis, the linearized stability theory and normal mode analysis have been used to study the effects of various important parameters like suspended particles, compressibility, rotation, magnetic field, Hall currents, solute gradient, variable gravity, porous medium, micropolar coefficient, coupling parameter, micropolar heat conduction parameter etc. on various stability problems of hydrodynamic and hydromagnetic systems of non-Newtonian fluids.

The thermal stability of a layer of Rivlin-Ericksen fluid heated and soluted from below in porous medium is considered to include the effect of suspended particles in the presence of uniform magnetic field, uniform rotation and variable gravity field. It is found that, for stationary convection, suspended particles have destabilizing effect, solute gradient has stabilizing effect whereas magnetic field, permeability and rotation have stabilizing/destabilizing effect under certain conditions. The principle of exchange of stabilities is satisfied in the absence of magnetic field, rotation and stable solute gradient. The presence of these parameters introduces oscillatory modes into the system.

The theoretical investigation of the effect of Hall currents, suspended particles, magnetic field, solute gradient, medium permeability and compressibility on thermal stability of a ferromagnetic fluid heated from below is studied. For the case of stationary convection, it is found that magnetic field, solute gradient and compressibility have stabilizing effect whereas suspended particles and Hall currents have destabilizing effect. Medium permeability has conditional effect in the presence of horizontal magnetic field.

Further, thermal stability of couple-stress fluid in the presence of magnetic field and rotation is investigated to include the effect of suspended particles. For stationary convection, it is found that suspended particles have destabilizing effect whereas rotation has always stabilizing effect on the system. The magnetic field and couple-stresses have a stabilizing/destabilizing effect
under certain conditions and the couple-stresses and magnetic field have stabilizing effect on the system in the absence of rotation. The principle of exchange of stabilities is observed to be satisfied in the absence of magnetic field and rotation parameters.

The thermal stability of a layer of micropolar fluid heated from below in the presence of Hall currents in porous medium has also been investigated. For the case of stationary convection, it is found that medium permeability has destabilizing effect whereas micropolar coefficient, Hall currents, magnetic field, coupling parameter and micropolar heat conduction parameter has stabilizing effect on the system.