CONCLUSIONS AND FUTURE SCOPE

6.1 CONCLUSIONS

The non-Newtonian fluids are of vital importance due to their diverse applications in modern technology, industries and bio-mechanics. In the present thesis, the linearized stability theory and normal mode analysis have been used to study the effect of various important parameters on thermal and thermosolutal stability of hydrodynamic and hydromagnetic systems of various non-Newtonian fluids.

In the chapter 2, thermal stability of a layer of Walters’ B’ fluid heated from below permeated with suspended particles is considered to include the effect of rotation in the presence of magnetic field, porous medium and compressibility. For the case of stationary convection, Walters’ B’ viscoelastic fluid behaves like a Newtonian fluid and suspended particles, compressibility have destabilizing effect whereas rotation has stabilizing effect. The magnetic field and porous medium have stabilizing/destabilizing effect under certain conditions. The principle of exchange of stabilities is satisfied in the absence of magnetic field, rotation and viscoelasticity. The presence of these parameters introduces oscillatory modes into the system. The critical Rayleigh numbers and the associated wave numbers are found for stationary convection for various parameters involved and it has been found that it increases with the increase in magnetic field, rotation and permeability parameter while decreases with the increase in suspended particle parameter and compressibility parameter thereby confirming the stabilizing role of magnetic field, rotation and permeability parameters and destabilizing role of suspended particles and compressibility parameters.

In chapter 3, the effect of suspended particles, magnetic field and rotation on thermal stability of a layer of ferromagnetic fluid heated from below have been analyzed and it is found that magnetic field, magnetization and rotation have stabilizing effect whereas suspended particles have destabilizing effect on the system. The critical Rayleigh numbers and the associated wave numbers are found for stationary convection for various parameters involved and it has been found that it increases with the increase in magnetic field, rotation and magnetization parameter and decreases with the increase in suspended particles parameter thereby confirming the stabilizing role of magnetic field, rotation and magnetization parameter and destabilizing role of suspended particles. The principle of exchange of stabilities is not valid for the problem under consideration whereas in the absence of magnetic field and rotation it is valid under certain conditions.
In chapter 4, Hall effect on thermal stability of couple stress fluids permeated with suspended particles has been considered. The couple stresses and Hall currents have stabilizing effect whereas suspended particles have destabilizing effect on the system. The magnetic field has stabilizing/destabilizing effect under certain conditions. The critical Rayleigh numbers and the associated wave numbers are found for stationary convection for various parameters involved and it has been found that it increases with the increase in magnetic field, couple stresses and Hall currents parameter and decreases with the increase in suspended particles parameter thereby confirming the stabilizing role of magnetic field, couple stresses and Hall currents parameter and destabilizing role of suspended particles. The principle of exchange of stabilities is satisfied in the absence of magnetic field (hence Hall currents) and suspended particles. Further, we also studied the effect of various parameters such as Hall currents, compressibility, magnetic field, suspended particles and porous medium on thermosolutal stability of Rivlin-Ericksen fluid. For a stationary convection, Rivlin-Ericksen fluid behaves like Newtonian fluid. The compressibility, suspended particles, Hall currents and permeability have destabilizing effect whereas solute gradient and magnetic field have stabilizing effect on the system. The critical Rayleigh numbers and the associated wave numbers are found for stationary convection for various parameters involved and it has been found that it increases with the increase in solute gradient and magnetic field parameters while decreases with the increase in suspended particles, compressibility, Hall currents and permeability parameters thereby confirming the stabilizing role of solute gradient and magnetic field and destabilizing role of suspended particles, compressibility, Hall currents and permeability parameters. The principle of exchange of stabilities is found to hold true in the absence of solute gradient and Hall currents.

Chapter 5 deals with double diffusive convection in a rotating nanofluid layer saturating a porous medium. The model used for the nanofluid incorporates the effect of Brownian motion and thermophoresis. The Taylor number $T_A$, modified diffusivity ratio $N_A$, Lewis number $L_e$, Darcy number $D_a$ and porosity $\varepsilon$ have stabilizing effect on the stationary convection. The solutal Rayleigh number $R_s$ has destabilizing effect on the stationary convection. The concentration Rayleigh number $R_n$ has stabilizing/destabilizing effect under certain conditions. The critical Rayleigh numbers and the associated wave numbers are found for stationary convection for various parameters involved and it has
been found that it increases with the increase in Taylor number, concentration Rayleigh number, modified diffusivity ratio and Lewis number and decreases with the increase in solutal Rayleigh number thereby confirming the stabilizing role of Taylor number, concentration Rayleigh number, modified diffusivity ratio and Lewis number and destabilizing role of solutal Rayleigh number.

6.2 FUTURE SCOPE

The various applications of the nanofluids are still in its primary stage and thus there is a plenty scope of exploration. The effect of various parameters like viscosity, variable gravity, variable magnetic field and variable particle size on the thermal and thermosolutal stability of nanofluids may be investigated. Further, different efficient numerical methods such as finite element method etc. may be implemented for non linear stability analysis of hydrodynamic and hydromagnetic systems. In this way, the present work leaves a wide scope for future research.