ABSTRACT

My research aims to analyze Hall current effects and double diffusive effects in the presence of suspended particles on the thermal instability of the non-Newtonian viscoelastic fluid whose non-linear relation between the stress and strain rate (which includes deformation, rotation, and extension) is given by Rivlin-Ericksen in 1955.

To understand the applied problem of real life, one must know the physics of the problem and be able to interpret the results obtained. In the introductory chapter, all the basics which are essential for the understanding of the problems discussed in thesis are well explained. Basic terms explained with the help of examples and real life applications. No problem can be solved without assumptions, so fundamental assumptions are also explained. In this chapter all the terms used in the thesis are explained for the understanding of general investigations in the subsequent chapters 2, 3, and 4. Flow governing equations based on the various principles of conservation like mass, momentum, and energy are discussed in detail. Fluid properties, fluid types like Newtonian and non-Newtonian fluid with their specific applications and uses are explained in this introductory chapter. Concept of hydrodynamic stability of the system in terms of various parameters is also explained. Also, light is thrown on the procedure of the problems formulated in the subsequent chapters.

Problem is formulated for non-Newtonian and viscoelastic fluid named Rivlin-Ericksen in porous medium in chapter 2. Fluid is permeated with suspended particles and a uniform magnetic field is also considered. Governing equations for the problem were obtained and the initial state of the system described in terms of various parameters like velocity field, pressure, magnetic field, etc. is perturbed or disturbed. All the disturbances analyzed and it is found that relation between strain rate and stress become linear in case of stationary convection. Perturbations due to the magnetic field were decaying while the perturbations due to the suspended particles and medium permeability were growing. Oscillatory modes exist only due to the presence of magnetic field.

Study devoted to the effect of magnetic field which change the direction of flow of electric current when applied at right angle to electric field on the thermal instability in porous medium of dusty viscoelastic fluid in chapter 3. Problem related to the effect of
hall current on the thermal instability of viscoelastic fluid with dust in porous medium was modeled in terms of mathematical equations, initial state of the system is perturbed as in previous chapter by giving small perturbations to the physical quantities like pressure, velocity, temperature, density and magnetic field etc. Linearize the system by neglecting all the non linear terms. Dispersion relation is obtained after the normal mode analysis. It is observed that perturbations due to suspended particles and hall current were growing while the perturbations due to the magnetic field and compressibility were decaying in the system for the case of stationary convection. Magnetic field stabilize the effect of permeability on thermal instability. Oscillatory modes were introduced by viscoelastic parameter, magnetic field and hall current. Behavior of hall current, permeability, magnetic field and suspended particles on the critical thermal Rayleigh number were shown graphically.

Double diffusive or thermosolutal convection i.e. the presence of more than one component with different diffusivities like heat and salt in the fluid layer, explained in chapter 4. Now temperature and salt field are two destabilizing sources for the density difference whereas in standard Bénard problem, temperature field is the only destabilizing source. This situation is similar to ocean where both salt and heat are present simultaneously and chemical engineering with two or more components of different molecular diffusivities. Also in case of stellar helium acts like salt in raising the density and diffusing more slowly than heat. Mathematical model for the problem of double-diffusive convection in presence of compressible fluid with fine dust was designed in terms of equation. Using the same procedure and techniques or methods as in previous chapters to find the solution. It is observed that relation between strain rate and stress become linear in case of stationary convection due to vanishing of viscoelastic parameter. Presence of stable solute gradient, suspended particles and viscoelasticity introduced oscillatory modes. The stable solute gradient and compressibility has a stabilizing effect and suspended particles hasten the onset of thermosolutal instability.

Programming codes were written for the variations of Rayleigh numbers obtained in the chapters 2, 3 and 4 by assigning numerical values to all other parameters, these codes will calculate the Rayleigh number and will also plot the graph.