ABSTRACT

The study of an electrically conducting fluid have many applications in engineering problems such as MHD generators, plasma studies, nuclear reactors, geothermal energy extraction, and the boundary layer control in the field of aero dynamics. The process of heat and mass transfer in free convection flow has many applications in chemical engineering processes, cooling device aeronautics and nuclear reactors.

This thesis details the effect of thermo physical parameters on heat and mass transfer. The main objective of this work is to investigate the effect of thermo physical parameters such as power law index of the surface temperature, variable viscosity, magnetic field, Eckert number, Prandtl number, Schmidt number, Reynolds number, permeability, radiation, Grashof number, velocity, temperature and concentration distribution on heat and mass transfer in a fluid flow on a stable and moving surface. Further, the influences of skin friction coefficient, Nusselt number and Sherwood number on heat and mass transfer in the fluid flow have also been illustrated.

In metallurgical process, the rates of cooling and stretching can be controlled by drawing the strips in an electrically conducting fluid subject to a magnetic field, so that a final product of desirable characteristics can be achieved.

The study of hydro magnetic boundary layers on stretching surface has attracted considerable interest because of its wide applications especially in engineering and industrial process. The problem of boundary layer flow over a continuous surface in the presence of hydro magnetic field is studied. A two dimensional steady flow of an electrically conducting viscous incompressible fluid past a continuously and uniformly moving surface in presence of uniform magnetic field is analysed. The magnetic Reynolds number is assumed to be small so that the induced magnetic field is neglected.

The study of the effect of power law index of the surface temperature variation, magnetic parameter on heat transfer and the results obtained have been analysed in detail shows that the heat transfer rate increases rapidly with the increase of power law index of the surface temperature whereas the heat transfer rate decreases when the magnetic parameter increases.

The free convection of heat transfer in flow past a semi infinite flat plate in transverse magnetic field with heat flux is investigated. Numerical solutions have been obtained and the analysis of the results shows that velocity and temperature decreases with increase in magnetic parameter and permeability parameter. However, increase in magnetic parameter and permeability parameter leads to fall in skin friction coefficient but increases the Nusselt number.

The effects of radiation on heat transfer over an exponentially stretching surface with Magneto hydrodynamic flow have been studied. The flow of viscous incompressible fluid over a stretching sheet has many applications in manufacturing industries and technological process, such as glass-fiber production, wire drawing, paper production, production of sheeting material etc,. The study of magneto-hydrodynamic flow of an electrically conducting fluid is of considerable interest in modern metallurgical and metal-working processes.

The partial differential governing equations are transformed into ordinary differential equations by similarity transformation method. The ordinary differential equations are then integrated using Runge-Kutta Gill method together with shooting technique.

Transformation of governing equations by integrating the resulting ordinary differential equations and the results obtained by shooting technique depicts the effect of various parameters such as magnetic field parameter, radiation parameter and Prandtl number on velocity and temperature profiles. It is evident that the transverse magnetic field opposes the transport phenomena. Further, with increase in magnetic parameter and radiation parameter, the thermal boundary layer thickness increases but opposite trends are observed for increasing values of Prandtl number. The surface shear stress increases with the magnetic parameter, while the heat transfer rate increases with Prandtl number, but decreases with both magnetic parameter and radiation parameter.

A numerical approach with variable temperature boundary conditions over a continuous moving plate has been studied. Quite often various industrial processes involving continuous surfaces that move steadily through a quiescent ambient environment exists for which a correct assessment of the axial temperature and concentration variation of the material are given relevant importance. Under the conditions, an increase in Prandtl number leads to an increase in the value of Nusselt number. It is clearly understood that when Schmidt number increases, the viscous boundary layer thickness decreases. Also, when Prandtl number increases, the thermal boundary layer thickness decreases.

The effect of chemical reaction, thermal radiation, internal heat generation, on chemically reacting MHD boundary layer flow of heat and mass transfer past a moving vertical plate with suction/injection has been studied in detail. For similarity boundary layer flows, the velocity profiles are similar. The results obtained reveal that the fluid velocity within boundary layer decreases with increasing magnetic field strength and wall suction and increase with wall injection. It is established that an increase in the wall suction enhances the boundary layer thickness and reduces the skin friction together with heat and mass transfer rate at the surface of the moving plate. In addition, the concentration of the chemical species within the boundary layer decreases with increase in Grashof number and Schmidt number.