SYNOPSIS

The importance of a thorough knowledge of science of heat transfer and the necessity of being able to analyze, quantitatively, problems involving transfer of heat have become increasing important as modern technology has become more and more complex. In almost every phase of scientific and engineering work, process involving the exchange of energy through a flow of heat are encountered. Recent technological implications have given rise to increased interest in mixed convection problems in vertical channels. The physical situations involve with buoyancy aided and opposed cases for laminar and turbulent flows.

Mechanical and chemical engineers are particularly concerned with problems of heat transfer. Modern power generation involves the production of work form either a combustible fuel or a nuclear reaction. This energy is converted into useful work by means of boilers, turbines, condensers, air heaters, water pre-heaters, pumps etc. All these pieces of apparatus involve a transfer of heat by one means or another, as does almost every piece of apparatus found in a chemical process industry or a petroleum refinery. Certainly designing the familiar internal combustion engines, gas turbines and jet engines requires a compute understanding of heat transfer for thorough analysis of the combustion and cooling processor. Convection is the term applied to energy transfer process which is observed to accure in fluids mainly because of the transport of energy by means of the motion of the fluid itself.
The Navier - Stokes's equations of motion of a viscous fluid along with the energy levels are, mathematically speaking, very complex. Exact solution to these equations are known for only a few cases, most of which have very specialised and often impractical boundary conditions. The complicated nature of these equations does not, however, eliminate the need for answers to problems of practical importance. For this reason an engineer must be contented with the compromise of accepting either an approximate solution to these fundamental equations, an exact solution to simplified or approximate versions of the equations of some times an approximate solution of approximate equations. This does not destroy the values of the exact fundamental equations, for they are necessary in order to understand the physical implications of making any approximation or simplification. Since the Navier - Stokes's equations express a balance among inertial forces, viscous forces, pressure forces and body forces, one such a simplification may come from neglecting certain of the forces has being small in comparison to others when the conditions of the flow and the relative magnitude of the terms will permit. Flow and heat transfer within porous media are of great practical interest. Applications include chemical reactors, thermal storage systems, thermal insulation, petroleum reservoirs, nuclear waste, etc.,

In this thesis an attempt is made to study the effect of magnetic field on different fluid flow problems. This thesis is divided in to Five Chapters and are given as:
Chapter I: Developing MHD Laminar free convection flow between vertical flat plates with asymmetric heating.

In this chapter, the laminar free convection developing flow between vertical flat plates with asymmetric heating under the influence of magnetic field is studied. The distance between the plates is taken as 'b'. Rectangular co-ordinate system is used. The fluid is taken to have a uniform vertical upward stream-wise velocity distribution at the channel entrance. The walls are heated at uniform temperature, since the temperatures of the two walls are different asymmetric heating occurs. A uniform transverse magnetic field of strength $H_0$ is applied perpendicular to the walls (i.e., in the y-direction). The flow problem is described by means of parabolic partial differential equations and solutions are obtained by a fully implicit numerical methods. The effect of Magnetic field on velocity, temperature and pressure is studied numerically for different values of the ratio of wall temperature and fixed Prandtl number.

Chapter 2: MHD Developing flow in a vertical channel with asymmetric wall temperature

In this chapter a theoretical study of mixed convection in a vertical flat channel is considered. In developing region the flow problem is described by means of parabolic partial differential equation and solutions are obtained by a fully implicit numerical method. Boundary conditions of uniform wall temperature are considered. The velocity and temperature distribution are obtained by solving the basic equations governing the flow by a finite difference technique. The effect of magnetic field on velocity, temperature is studied numerically for different values of the ratio of wall temperature and fixed Prandtl number.
Chapter 3: Laminar MHD flow in the entrance region of a plane channel

In this chapter we deal with the velocity and temperature profiles in the entrance region for laminar MHD flow between parallel plates. The channel is of height ‘2a’ and width ‘d’. It has an arbitrary length, but the length must be long compared with the development length and the height. A rectangular co-ordinate system is used with origin as the centre of the channel. The equations of the system are placed in a finite difference form and solved numerically for various Hartmann, Prandtl and Eckert numbers.

Chapter 4: Laminar MHD flow in the entrance region of an annular channel.

In this chapter the motion of a laminar conducting flow between two insulating cylinders, which are concentric, is considered. The cylindrical co-ordinate system (r, θ, z) is used. The origin of the co-ordinate system is located at the extreme left of the channel along the center line of the cylinders. ‘z’ is co-ordinate which increases in the downstream direction, ‘r’ is the radial co-ordinate and ‘θ’ is the angular co-ordinate and is perpendicular to the (r, θ, z) plane. A uniform magnetic field of strength ‘H_c’ is applied in the radial direction. The effect of magnetic field in the velocity is discussed numerically.

Chapter 5: Effect of magnetic field on a free convection flow along a vertical wall in a porous medium

In this chapter, we study the effect of magnetic field on a free convection flow along a vertical wall in a porous medium. The flow is dealt with two dimensional. It is well-known that for constant wall temperature and permeability, this problem has no similarity solution and hence we have to deal with governing partial differential equations of the system. The steady
state equations are solved with the help of highly implicit difference scheme.
The difference equations are non-linear which have been solved by using
iterative technique. The effect of magnetic field on velocity and temperature
fields are studied for fixed permeability parameter.

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References

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