ABSTRACT

Flow through porous media under the influence of inclined magnetic field has been attracted considerable research activity in recent years because of its several important applications notably in the flow of oil through porous rock, the extraction of energy from the geothermal regions, the evaluation of capability of heat removal from particulate nuclear in a nuclear reactor, the filtration of solids from liquids, flow of liquids through ion exchange beds, drug permeation through human skin, chemical reactors for the economical separation or purification of mixture and so on.

Heat transfer in porous media has received considerable attention and has been the field of a number of investigations during the last two decade. The need for fundamental studies in porous media heat transfer stems from the fact that a better understanding of a host of thermal engineering applications in which porous materials are present is required. Some of examples of thermal engineering disciplines which stand to benefit from a better understanding of heat and fluid flow processes through porous media are geothermal systems, thermal insulations, grain storage, solid matrix heat exchangers, oil extraction and manufacturing numerous products in the chemical industry.

The application of electromagnetic fields in controlling the heat transfer as in aerodynamic heating leads to the study of magneto hydrodynamic heat transfer. This MHD heat transfer has gained
significance owing to recent advancement of space technology. The
MHD heat transfer can be divided in two parts. One contains problems
in which the heating is an incidental by product of electromagnetic
fields as in MHD generators and pumps etc, and the second consists of
problems in which the primary use of electromagnetic fields is to
control the heat transfer.

Keeping the above mention facts in view in this thesis an attempt
has been made to discuss the steady and unsteady hydro magnetic
flows of incompressible viscous Newtonian and Non-Newtonian fluids
through porous medium in planar channel under the influence of
inclined magnetic field.

In the first chapter, we discuss the basic concepts, aims and
objectives, some important applications of fluid mechanics and porous
media and the fluid flow through porous medium.

In the first Problem, we discuss the unsteady hydro magnetic
flow of an electrically conducting Maxwell fluid in a parallel plate
channel bounded by porous medium under the influence of a uniform
magnetic field of strength $H_0$ inclined at an angle of inclination $\alpha$ with
the normal to the boundaries. The perturbations are created by a
constant pressure gradient along the plates. The time required for the
transient state to decay and the ultimate steady state solution are
discussed in detail. The exact solutions for the velocity of the Maxwell
fluid consists of steady state are analytically derived, its behaviour
computationally discussed with reference to various governing
parameters with the help of graphs. The shear stresses on the boundaries are also obtained analytically and their behaviour is computationally discussed in detail.

In the Second Problem, we investigate effects of hall currents and inclined magnetic field on the unsteady flow of incompressible electrically conducting Maxwell fluid through a porous medium in a parallel plate channel, the perturbations in the flow are created by a prescribed pressure gradient. The governing equations are solved using Laplace transform method and have been discussed in detail. The final steady state velocity and shear stresses have been evaluated analytically and their behavior is computationally discussed for different variations in the governing parameters.

In the Third Problem, we discussed the unsteady magneto hydrodynamic flow of an electrically conducting viscous incompressible non-Newtonian Bingham fluid through a porous medium bounded by two parallel non-conducting porous plates with heat transfer considering the hall current effects into account. The fluid is driven by a uniform pressure gradient parallel to the channel plates and the entire flow field is subjected to a uniform magnetic field of strength $H_0$ with the normal to the boundaries in the transverse $xz$-plane. An external uniform magnetic field is applied perpendicular to the plates and the fluid motion is subjected to a uniform suction and injection. The lower plate is stationary and the upper plate moves with a constant velocity and the two plates are kept at different but constant temperatures.
Numerical solutions are obtained for the governing momentum and energy equations taking the Joule and viscous dissipations into consideration. The effects of the Hall term, the parameter describing the non-Newtonian behaviour, and the velocity of suction and injection on both the velocity and temperature distributions is studied.

In the **Fourth Problem**, we study the steady and unsteady MHD viscous, incompressible free and forced convective flow of an electrically conducting Newtonian fluid through a porous medium under the influence of a uniform inclined magnetic field of strength $H_0$ inclined at an angle of inclination $\alpha$ with the normal to the boundaries and in the presence of appreciable thermal radiation heat transfer and surface temperature oscillation taking hall current into account. Secondary (cross-flow) effects are incorporated. The governing equations are solved analytically using complex variables. Detailed computations of the influence of governing parameters on the unsteady mean flow velocity and unsteady mean cross flow velocity, the plate shear stresses for the unsteady main and the secondary flow and also temperature gradients due to the unsteady main flow and the unsteady cross flow are presented graphically and tabulated. The closed form solutions reveal that the shear stress component due to a steady mean flow experiences a non-periodic oscillation which varies as a function of the Hartmann number and radiation parameter. However the shear stress components due to main and cross flows for an unsteady mean flow are subjected to periodic oscillation which depends on Hartmann number, inverse Darcy parameter, radiation parameter but also on the Prandtl
number and frequency of oscillation. Applications of the model include fundamental magneto-fluid dynamics, MHD energy systems and magneto-metallurgical processing for aircraft materials.

In the Fifth Problem, we discuss the steady hydro magnetic three dimensional couette flow of an incompressible viscous flow through a porous medium between two infinite parallel plates under the influence of effect of inclined magnetic field and taking viscous dissipation into account. The stationary plate is subjected to a slightly sinusoidal surface temperature with transverse sinusoidal suction velocity while moving plate is isothermal with injection velocity. The velocity and the temperature are evaluated by using perturbation technique. The expressions for the components of skin friction at the stationary plate and the insulated plate and the rate of heat transfer are also obtained and its behaviour computationally discussed with reference to the various governing parameters in detail.

All problems of our work are only mathematical models and to apply anywhere in applications of fluid dynamics related to this especially in case of non-Newtonian fluids. For example several fluids including butter, cosmetics, toiletries, paints, lubricants, certain oils, blood, mud, jams, jellies, shampoo, soaps, soups and marmalades have rheological characteristics and are referred to as non-Newtonian fluids. The results of Bingham fluid problem are important for the design of the duct wall and the cooling arrangements.