SYNOPSIS

This thesis consisting of eight chapters is devoted to the study of some flows through and past porous beds. Chapter one is introductory and contains a brief account of the basic equations and a review of the literature directly related to our work.

In Chapter II, we study the buoyancy induced flows in a saturated porous medium adjacent to vertical impermeable surfaces on the basis of similarity solutions with wall temperature varying as a power function of distance from the origin. We also consider the range for the surface temperature variation to correspond to physically realistic situations. We examine the effect of temperature variation on the horizontal velocity at infinity, the thickness of the boundary layer, and the surface heat flux. We also analyse the fully developed convective flow through a vertical porous channel bounded by impermeable surfaces.

Chapter III deals with the problem of free and forced convection in a vertical channel as affected by wall permeability. The effect of wall permeability on the fully developed convective flow and heat transfer is investigated. It is found that the effect of the permeable bed is to

increase the mass flow through the fluid chamber. However, in the case of cooling from below, the mass flow decreases as the Rayleigh number increases while in the case of heating from below it increases with Rayleigh number. In the case of heating from below, the critical Rayleigh number at which flow-instability occurs decreases as the permeability increases. The effects of permeability on the buoyancy and velocity fields have been illustrated by means of graphs.

Chapter IV is devoted to the study of laminar mixed convection in a vertical circular pipe bounded by a permeable wall. The two cases of pipe temperature increasing with height and that of decreasing with height are considered. Closed form solutions for thermal and velocity fields in both the cases are obtained. It is found that as permeability increases, the mass flow and heat transfer increase in both the cases but the role of Rayleigh number is found to be opposite in the two cases. It is further noticed that permeability tends to quicken the transition of flow-field towards instability.

In Chapter V we discuss two dimensional and axisymmetric steady laminar stagnation point flow of a viscous fluid over a saturated permeable bed with an impermeable underside. We find on the basis of Beavers-Joseph condition that permeability tends to increase the slip velocity. As a result, there is a reduction in normal and shearing stresses at the wall. It is further found that the stagnation-point is shifted to the underside of the porous bed. Thus, the depth of the porous bed is found to have a direct influence on the flow-characteristics and slip velocity at the interface.

Chapter VI deals with the laminar motion of a viscous fluid in a curved tube of circular cross section bounded by a permeable layer. It is found that permeability tends to increase the mass flow through the tube. As the size of the bed is increased, the mass flow is found to decrease due to the suction of flow by the permeable bed.

Chapter VII treats the steady flow between a rotating disk and a stationary naturally permeable disk. It is found that the two disks tend to repel each other as the permeability of the stationary disk is increased. On the other hand, for a fixed value of permeability, the two disks tend to attract each other as the structural parameter α of the porous medium increases. Furthermore, permeability of the bed is responsible for an azimuthal slip which in turn generates rotation at the fluid-disk interface.

Chapter VIII is devoted to the study of oscillatory flow past and against a porous bed on the basis of generalised Darcy law. We find that while the flow remains linear, we obtain results usually associated with non-linear problems.

We further find that due to the interaction of oscillatory tangential component with time-dependent suction, a mean flow is induced both inside and outside the porous bed.