ABSTRACT

The study of heat and mass transfer and fluid dynamic in saturated porous media involves several different fields of interest such as modeling of cooling/heating devices, gases are transferred to blood within the lung, CO₂ sequestration and delivery of drugs to the brain are few examples of the widespread fields involved. The solution of the problem of transfer of mass, energy and electrically conducting fluids has considerable importance to many practical processes. To solve the differential equations of heat, electricity, conduction and diffusion, numerous methods have been developed. Heat transfer takes place in three modes such as convection, conduction and radiation. The analysis of heat transfer plays an important role in the design of several industrial and commercial equipments, such as closed feed, water heaters and surface condensers for refrigeration, lubrication of bearings, cooling compressors of engine cylinders, nuclear technology and aircraft engineering. Modern development in the field of laminar and turbulent flows along with the boundary layer theory has led to the study of heat transfer process to a large extent in view of above developments.

When a conductive fluid moves through a transverse magnetic strength field, an ionized gas is electrically conductive may be influenced by the magnetic field. Magneto hydrodynamic (MHD) mixed convection heat transfer flow in porous and non-porous media is of considerable interest in the technical field due to its frequent
occurrence in industrial technology and geothermal application, high
temperature plasmas applicable to MHD power generation systems,
nuclear fusion energy conversion and liquid metal fluids.

Over the past two decades, studies in aerosol particle deposition
due to thermophoresis have gained importance for engineering
applications. The gas molecules coming from the hot side of the
particles have a greater velocity than those coming from the cold side.
The molecules which move fast collide more forcefully with the
particles. This difference in momentum leads to the particle
developing a velocity in the direction of the cooler temperature.
Thermophoresis causes small particles to deposit on cold surfaces.
Thermophoresis phenomena is applied to manufacture graded index
silicon dioxide and germanium dioxide optical fiber performs used in
the field of communications.

In many transport processes existing in nature and in industrial
applications in which heat and mass transfer is a consequence of
buoyancy effects caused by diffusion of heat and chemical species. In
addition, chemical reactions can be classified as either heterogeneous
or homogeneous processes. The reaction is heterogeneous if it takes
place at an interface and homogeneous if it takes place in solution.
The reaction rate depends on the concentration of the species itself.

The study of heat generation/absorption effects in moving fluids
is important in view of several physical problems like fluids
undergoing exothermic or endothermic chemical reaction. The cooling
of electronic equipment ranges from individual transistors to main frame computers, supplying energy to telephone switch boards and thermal diffusion effects on isotopes separation in the mixture between gases with very light molecule weight (hydrogen and helium) and medium molecular weight.

The Dufour and Soret effects were neglected since they are of a smaller order of magnitude than the effects described by Fourier’s and Fick’s laws. When the heat and mass transfer occurs simultaneously in a fluid flow, the relations between the fluxes and the driving potentials are more complicated. The energy flux can be generated by the temperature gradients and composition gradients. The mass transfer caused by the temperature gradient is called the Soret effect, while the heat transfer caused by the concentration gradient is called the Dufour effect.

The governing partial differential equations are converted into ordinary differential equations by similarity transformations. A similarity solution for the transformed governing equations is obtained. The coupled non-linear ordinary equations are linearized by using Quasi-linearization technique. The governing coupled ordinary differential equations are being solved by employing an implicit finite difference scheme. Numerical computation are carried out for the non dimensional physical parameters.

The coupled nonlinear ordinary differential equations are linearized by using Quasi-linearization technique [14] and implicit
finite difference scheme is used to solve these partial differential equations. The numerical computations are carried out for the different physical parameters such as thermophoretic, inertia parameter, buoyancy ratio, mixed convection, Schmidt number on the flow and chemical reaction, heat and mass transfer characterized.

The thesis entitled “Numerical study of MHD heat and mass transfer in Darcy-Forchheimer mixed convection from a vertical flat plate in a porous medium under the effects of radiation, thermophoretic and chemical reaction” has been grouped into seven chapters.

First, the general introduction is given in chapter 1, in it certain elementary concepts and definitions for the sake of ready reference and for the use in subsequent chapters are presented.

The Chapter 2 demonstrates the problem on “Thermophoresis and chemical reaction effects on MHD Darcy-Forchheimer mixed convection in a fluid saturated porous media”.

Chapter 3 of this thesis deals with “Soret and Dufour effects on heat and mass transfer in Darcy-Forchheimer MHD mixed convection from a vertical flat plate embedded in a fluid saturated porous medium with the effects of Radiation and Thermophoresis ”.

The objective of Chapter 4 consists of problem on “MHD effects on Darcy-Forchheimer mixed convection in a fluid saturated porous media with chemical reaction and viscous dissipation”.

Chapter 5 deals with the problem of "Influence of thermophoresis and MHD on non-darcy mixed convection heat and
mass transfer along a vertical flat plate embedded in a porous medium in presence of radiation”.

The purpose of **Chapter 6** is to study the problem on “Soret and Dufour effects on the boundary layer radiative MHD flow over a vertical plate in the presence of chemical reaction and viscous dissipation”.

**Chapter 7** of this thesis deals with ”MHD effects on non-Newtonian micro polar fluid with uniform suction/blowing and heat generation in the presence of chemical reaction and thermophoresis”.