PREFACE

Fluid dynamics is one of the most important areas of physics. It is obvious that life would not exist without fluids and without the behavior that fluids exhibit. The air we breathe in and the water we drink (and which makes up most of our body mass) are fluids. Motion of air keeps us comfortable in a warm room, and air provides the oxygen we need to sustain life.

Mechanics is the oldest physical science that deals with both stationary and moving bodies under the influence of forces. The branch of mechanics that deals with bodies at rest is called statics, while the branch that deals with bodies in motion is called dynamics. The subcategory fluid mechanics is defined as the science that deals with the behavior of fluids at rest (fluid statics) or in motion (fluid dynamics), and the interaction of fluids with solids or other fluids at the boundaries. Fluid mechanics is also referred as fluid dynamics by considering fluids at rest as a special case of motion with zero velocity.

A substance exists in three primary phases: solid, liquid and gas. A substance in the liquid or gas phase is referred to as a fluid. Distinction between a solid and a fluid is made on the basis of the substance’s ability to resist an applied shear (or tangential) stress that tends to change its shape. A solid can resist an applied shear stress by deforming, whereas a fluid deforms continuously under the influence of a shear stress, no matter how small. In solids, stress is proportional to strain, but in fluids, stress is proportional to strain rate. When a constant shear force is applied, a solid eventually stops deforming at some fixed strain angle, whereas a fluid never stops deforming and approaches a constant rate of strain.

In current years magnetohydrodynamic boundary layer fluid flows with heat and mass transfer along with porous medium have been attracting many researchers because of its significant role in several fields of science and technology. These flow phenomena are used in atmospheric sciences to predict long-range weather conditions and to analyse climate changes. This is utilized to inspect the underground water resources and water discharge in river beds as well as agricultural field. In chemical engineering, primarily
for filtration and refinement process and in petroleum machinery, to estimate the movement of natural gas, water and different oils in the oil reservoirs etc., many applications of these boundary layer flows are adopted.

This thesis analyses the characteristics of MHD free convective heat and mass transfer flow of some Newtonian and non-Newtonian fluids through a porous medium. A theoretical study has been carried out to examine the physical properties of this flow. Different types of problems with several parameters are considered. The governing equations pertaining to the fluid flow are converted to non-dimensional form and then solved by applying perturbation method; finite difference scheme and also Laplace transform technique.

The entire thesis is classified into seven chapters. The basic concepts of MHD, heat and mass transfer along with governing equations associated with energy, conservation of momentum, conservation of mass and molecular diffusion are presented in chapter 1. This chapter also explains the fundamental concepts of fluid dynamics related to this study. The second chapter presents the literature survey which consists of the contributions of several researchers around the globe in the area of fluid dynamics related to Newtonian and non-Newtonian fluids with different flow geometries.

In chapter 3 an attempt is made to investigate on MHD convective chemically reactive and absorbing fluid flow along an exponentially accelerated vertical plate with Hall current and ramped temperature. Laplace transform technique is applied to obtain exact solutions of the non-dimensional governing equations for fluid velocity, temperature and concentration. In fourth chapter numerical analysis is carried out for the case of Soret and Dufour effects on radiation absorption fluid past a linearly accelerated vertical porous plate in the presence of exponentially varying temperature and concentration in conducting field using finite difference method.

Chapter 5 also analyzes a numerical study on unsteady magnetohydrodynamic free convective heat and mass transfer flow of heat generating, chemically reacting and radiation absorption Casson fluid flow past an oscillating vertical plate embedded in a
porous medium in the presence of constant wall temperature and concentration. The non-dimensional governing equations along with the corresponding boundary conditions are solved using finite difference method numerically. In the sixth chapter influence of radiation absorption on an unsteady MHD free convection flow of a viscous, incompressible and electrically conducting, well known non-Newtonian fluid named as Kuvshinski fluid past an infinite vertical porous plate in the presence of homogeneous chemical reaction and heat source/sink is studied analytically. The dimensionless governing equations are solved analytically using two terms harmonic and non-harmonic functions.

The seventh chapter covers the summary and conclusions of studies mentioned above. This chapter also depicts physical parameters concerned to the governing equations of the problems and their influences on the fluid flow vividly. The possible scope for extending the above studies is also mentioned. For the validity, we have checked our results with previously published work and found to be in good agreement with existing results. The contents of chapters 4, 5 and 6 are published in peer reviewed Scopus indexed international journals.