OHMIC DISSIPATION AND DIFFUSION-THERMO EFFECT ON MHD NATURAL FLOW THROUGH AN INFINITE VERTICAL POROUS PLATE WITH CONSTANT HEAT AND MASS FLUX

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1. INTRODUCTION & OBJECTIVE

Magnetohydrodynamics is the field of fluid mechanics dealing with the dynamics of electrically conducting fluid in the presence of magnetic field. Due to wide range of its practical applications, it has attracted significant attention of scientific and engineering communities. MHD principle is employed in the design of heat exchangers pumps and flow meters, extrusion of plastics in the manufacture of rayon and nylon, power generation etc. MHD plays an important role in many industrial processes, geophysics and astrophysics.

Viscous dissipation effects are usually ignored in macro scale systems, in laminar flow in particular, except for very viscous liquids at comparatively high velocities. However, even for common liquids at laminar Reynolds numbers, frictional effects in macro scale systems may change the energy equation. During the motion of fluid particles, viscosity of the fluid converts some kinetic energy into thermal energy. As this process is irreversible and caused due to viscosity, so this is called viscous dissipation. Thus, viscous dissipation effects may be very significant for fluids with high viscosities and low specific heat capacities, even at relatively low Reynolds numbers. Joule heating, also known as ohmic dissipation and resistive heating is the process by which the passes of an electric current through a conductor produces heat.

The main objective of the present work is to study the effects of diffusion-thermo and Joule heating in MHD heat and mass transfer convective flow passing through a porous vertical plate in presence of thermal radiation. The plate is subjected to a uniform suction, constant heat and mass flux.

2. RESULTS & HIGHLIGHTS OF IMPOINTANT POINTS

The present study leads to attain at the following important results:

I. Fluid velocity diminutions due to imposition of magnetic field and thus magnetic field can be effectively used in controlling the fluid motion.

II. Fluid motion is decreased with the increase in thermal radiation, Prandtl number and Schmidt number.

III. Velocity of the fluid gets accelerated with the influence of diffusion-thermo parameter.

IV. Fluid velocity enhances with the increasing values of permeability parameter.

V. Temperature of the fluid drops under the influence of Prandtl number, thermal radiation, and magnetic parameter.

VI. Thermal boundary layer gets increased with the increasing values of Dufour number and permeability parameter.

VII. Concentration of the fluid decreases due to chemical reaction and Schmidt number.

VIII. Skin friction at the wall rises for increasing values of diffusion-thermo parameter and permeability parameter. In the other hand, it is reduced due to the application of transverse magnetic field.

IX. The temperature of the plate decreases due to the effect of the magnetic field, Schmidt number and Prandtl number whereas the plate temperature rises with increasing values of Dufour number and permeability parameter.

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