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Magneto-Compound Reaction of Convective Flow via a Porous Inclined Plate with Heat Energy Absorption

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Abstract The current study is concerned with the unsteady heat and mass transfer of MHD free convection flow via a porous inclined plate that accelerates exponentially with temperature and concentration. Heat emission, source/sink, radiation absorption, and reaction are taken into account in the energy and species equations. The innovative part of the work is the analysis of the flow phenomenon with a heat source or sink and radiation absorption along the chemical reaction. The governing PDEs are reduced into ODEs via the non-dimensional variables and afterward solved analytically utilizing the perturbation strategy. Graphical representations of liquid temperature, speed, and concentration as well as the Sherwood & Nusselt quantities and the skin friction factor are displayed in tabular form for different combinations of appropriate stream quantities. The analysis of a resistance quantum grows with the size of the magnetic, whereas the rates of mass and heat transfer decline with increasing radiation, reaction, and Schmidt number. Thermal-velocity and concentration-velocity profiles interact reciprocally with the accelerating radiation, heat source, and compound reaction. The growth of speed and thermal profiles is clearly visible due to the absorption and Prandtl values. The present results are in strongly consistent with the earlier published results. There are numerous applications for this research in many sectors and material processing for understanding drag in seepage flows on heated/cooled and inclined surfaces.

Keywords Convection Flow, MHD, porous medium, chemical reaction, inclined plate, radiation

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1. Introduction

One of the most intriguing research topics over the past 200 years has been on the phenomenon of convection flows in porous media. This fascination is a result of

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its wide range of uses, which include electronic cooling, geothermal and building filtration systems, metallurgy, oceanography, chemical industries, etc. Husain et al. [1] and Siddartha et al. [2] reviewed the various applications (e.g. the design of atomic reactor, ventilation in building, aircraft cabin protection, electronic gear cooling, warming control, etc.) on the warm execution of natural convective flow through vertical annulus. A report on natural convective flow via an inclined plate was published by Roy et al. [3]. Abderrahmane et al. [4] scrutinized the convective flow of nanofluid due to a porous tending annulus by using a finite element technique. Convective flow of nanofluid via porous inclined wavy cavity was published by Ahmed [5], who concluded that it is more compelling for the rate of heat transmission compared to the restricting case. Khan et al. [6] examined the convective elements of pressing steam due to slanted rheology by using a homotopic system and found that the Ohmic warming and dissipation are utilized to upgrade the heat move. The convection flow towards an inclined channel plate was inspected by Kumar and Chandran [7]. Yang et al. [8] demonstrated the Laplace and Fourier sine transforms for convective steam of bio-nanofluid and found that the nanofluid speed diminished with upgrading of the second-grade liquid boundary.

The research in MHD steam of electrically conductive liquid is really of incredible importance because the magnetic field impacts on the boundary layer stream regulation control along with the adequacy of various frameworks utilizing electrically conductive fluids and their application in many engineering problems. For example, industrial machinery like pumps, bearings, generators of MHD, boundary control, etc., are impacted by the interaction of an electrically conducting fluid. Zafar et al. [9] projected the convective stream on an inclined plate through a magnetic field. They predicted that the magnetic field strength would be controlled by the fluid motion and also the magnetic field inclination point. The unsteady 2D convective flow of magnetic nanofluid was examined by Geridomez and Oztop [10]. They concluded that convective hotness increases with one-sided radiator length, volume fraction, and Rayleigh number, but decreases with an increase in Lorentz power. Ali et al. [11] demonstrated the magneto convective nanofluid flow in a rotating system filled with cavities by FEM and noticed that the magnetic field strength constricts the smooth movement and heat transfer rate extensively. Roy [12] obtained the solutions for the convective flow of a hybrid nanofluid via rectangular enclosure by FDM. He found that the steam function is reciprocal with the magnetic field and Rayleigh number, but the streamlines are in symmetry when the magnetic field angle is zero and $\pi/2$. Researchers [13]- [22] have been examining the various features of the convective flow of Williamson nanofluid together with a magnetic field.

Thermal radiation is used in many areas, such as agriculture (i.e., to improve food production and packaging), archaeology, space exploration, law enforcement, geology, etc. For example, by removing toxic pollutants (i.e., exacting gases from industry and coal-terminated power stations), electron beam radiation can remove dangerous NO_2 and SO_2 from our environment. In addition, the large number of textures cases our attire to have been lighted (i.e., treated by energy) prior to being presented to a dirt delivering or wrinkle-safe, compound and tissue therapy makes the chemicals bind to the fabric so that it keeps our fresh clothing and wrinkle-free all day. The authors [23], [24] published the heat charge impact on magneto-radiative nano & hybrid nanofluids via a porous elastic sheet. The study is used in medical fields (i.e. drug delivery, cancer therapy, etc.), magnetic power production processes, etc. Radiative Sakiadis flow via a tending plate was examined by Abbas