UNIVERSITI TEKNOLOGI MARA

MAGNETOHYDRODYNAMIC (MHD) BOUNDARY LAYER FLOW VIA AN INCLINED STRETCHING SHEET WITH THERMAL RADIATION AND RICHARDSON NUMBER

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ABSTRACT

This research investigates how thermal radiation and mixed convection influence the steady boundary-layer flow of an electrically conducting Newtonian fluid over an inclined stretching sheet under magnetohydrodynamic (MHD) conditions. The study focuses on the influence of these parameters on the fluid flow behaviour and heat transfer characteristics of electrically conducting fluids, which are widely encountered in industrial applications such as polymer extrusion, metal processing, and manufacturing. To analyse the physical problem, the governing equations representing the continuity, momentum, and energy equations are converted into a system of ordinary differential equations through similarity transformations and the transformed equations are solved numerically using the Runge-Kutta-Fehlberg (RKF45) method. The numerical investigation considers several dimensionless parameters, including the magnetic parameter, Richardson number, inclination angle, thermal radiation parameter, and Prandtl number, to evaluate their effects on velocity and temperature distributions as well as the skin-friction coefficient and local Nusselt number. Increasing the magnetic parameter strengthens the Lorentz force, which opposes the fluid motion. Consequently, the fluid velocity decreases, while the temperature and thermal boundary-layer thickness increase. Higher Richardson numbers and larger inclination angles enhance the fluid velocity because the buoyancy force becomes more dominant. An increase in the thermal radiation parameter raises the fluid temperature, reducing the heat transfer rate at the surface but larger Prandtl number produces a thinner thermal boundary layer, resulting in an improvement in the surface heat transfer rate.