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Thermodynamics Analysis for a Heated Gravity-Driven Hydromagnetic Couple Stress Film with Viscous Dissipation Effects

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Abstract: This paper addresses the development of entropy generation in the flow and heat transfer of an electrically conducting couple stress fluid film down an inclined heated plate. The balanced momentum and energy equations for the couple stress fluid are formulated based on the first and second laws of thermodynamics, the equations are non-dimensionalized and solutions are constructed based on simplifying assumptions. Variations of thermo-physical parameters are conducted on the velocity and temperature profiles including skin friction, heat transfer rate, entropy generation rate and Bejan number are shown graphically with extensive discussions. The effect of increasing couple stresses on the thin film fluid on the heated plate turns out to enhance the flow velocity and lowers the temperature distribution across the inclined plate. The result of the computation is useful in various metallurgical engineering and industrial processes.

Keywords: MHD Free and adiabatic surface Couple stresses Entropy analysis