Thermal Analysis of Eyring-Powell Hybrid Nanofluid: A Case of Combined Convective Transport and Radiative Heat Flux along Inclined Stretching/Shrinking Sheet

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Abstract: - Hybrid nanofluids are designed to improve conventional nanofluids' stability and other thermal properties. The present work investigates the flow of combined convective transport and the influence of radiation on the studied flow. A hybrid nanofluid ($Cu - Al_2O_3$/water) flows through a vertically inclined stretching/shrinking sheet. To simplify the governing equations, the deterministic two-variable differential equations (PDEs) are systematically transformed into a system of one-variable differential equations by using appropriate similarity transformations. The bvp4c function of the MATLAB program is also used to solve the simplified mathematical model. The present study investigates and presents in tabular and graphical form the effects of stretching/shrinking surfaces, suction, and volume fraction of the nanoparticles on the velocity and temperature profiles as well as on the engineering quantities. The present results are first validated and confirmed as acceptable before the full calculations are performed. Overall, the results of this study show that the investigated parameters influence the flow characteristics, which can serve as a controlling factor for heat transfer.

Key-Words: - Hybrid nanofluid, Eyring-Powell, mixed convection, inclined stretching/shrinking sheet, dual solution, radiation.

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1 Introduction

In engineering and industrial applications, problems related to the performance of energy are crucial. Most fluids immiscible with convection heat, including ethylene glycol, water, and oil, have low thermal conductivity; therefore, heat transfer is limited. Nanofluids are used to increase thermal efficiency. [1], first proposed the concept of nanofluids and defined them as mixtures with dispersed nanometer-sized particles as the base fluid. Considering their importance in thermal and energy efficiency, hybrid nanofluids are widely used in numerical and experimental studies in the field of fluid dynamics. Two different types of nanoparticles are combined to create composite/hybrid nanoparticles: metal oxides (alumina, copper oxide, magnetite, hematite), metals (silver, copper), carbonaceous materials (carbon nanotubes, graphite), or metal carbide. [2], modified the