Irreversibility Nonlinear Mixed Convective Time-Based Flow Analysis of Casson-Williamson Nanofluid Accelerated by Curved Melting Stretching Surface with Higher Order Slip

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Abstract: The focus has been placed on mathematically elucidating the nonlinear mixed convective unsteady flow of Casson-Williamson nanofluid transported across a curved melting stretched sheet using thermal radiation, Joule heating, an exponential heat source, and chemical reactions. Conditions for second order slip and melting heat are present on the surface's perimeter. Similarity catalysts are used to convert the partial differential equations that show the specified flow into straightforward ordinary differential equations. The solution graphs for the problem under consideration have been created using a Runge-Kutta-Fehlberg tool of order 4-5. The remaining parameters are simultaneously adjusted to their standard values as the solution graphs for each flow defining profile are shown with the corresponding parameters. In addition to the Bejan number, the entropy produced by the system is examined. On each presented graph, a thorough analysis has been done. Here, the study shows that a rise in non-linear solutal convection, non-linear thermal convection, mixed convection, and the ratio of buoyancy forces promote the velocity distribution. The magnifying radiation parameter has a rising trend in the thermal distribution, whereas the melting parameter has a decreasing trend. The Brinkman number and diffusion parameter have the most effects on irreversibility in the medium. The Sherwood number decreases with larger values of the Schmidt number, and skin friction decreases when the sheet is more likely to stretch with higher acceleration. In order to illustrate flow and heat patterns and to summarise the study, streamlines and isotherms are used in the graphs.

Keywords: Curved melting stretching sheet; Casson-Williamson nanofluid; nonlinear mixed convection; second order slip flow; Joule heating; entropy analysis.