Abstract No: PO-14

Viscous Dissipation and thermal radiation of Williamson fluid flow over an exponentially stretching sheet

N. G. A. Karunathilake[1*], W. P. T. Hansameenu[1] and G. S. Wijesiri[1]

[1]Department of Mathematics, University of Kelaniya, Sri Lanka
gamage@kln.ac.lk*

This study investigates the viscous dissipation and thermal radiation of Williamson fluid flow over an exponentially stretching sheet. The analysis has been started with the governing equations of the fluid flow derived from the conservation of mass, momentum, energy, and concentration. The internal heat generation and absorption effect in the view of getting the influence of temperature difference between the free stream and stretching sheet have been incorporated. The Rosseland approximation and Taylor series expansion formulate the radiative heat flux. The density difference which interacts with the gravitational force, resulting in a natural convection heat and mass transfer process is described by the mass transfer phenomenon with the homogeneous first-order chemical reaction effect. The boundary layer approximations have been introduced to focus on the fluid flow near the stretching sheet. Furthermore, the governing system of partial differential equations has been converted into a nonlinear ordinary differential equation by using similarity transformations. The resulting non-linear coupled system of ordinary differential equations has been solved numerically by shooting techniques. The graphs have simulated and presented the qualitative impact of different flow parameters such as magnetic field, Prandtl number, Williamson number, Grashof number, and thermal radioactive parameter on the radial velocity, temperature, and mass concentration profiles. The study reveals that the Prandtl number intensifies the radial velocity and has a mixed impact on the temperature and concentration, which decreases with an increase in the magnetic parameter but increases temperature and concentration. Further with the increase of the Prandtl number, the velocity and the temperature decrease in general but increase the concentration. The radial velocity increases with the Radioactive parameter but the temperature and the concentration display mixed reactions to the parameter. The Grashof parameter intensifies the radial velocity but reduces the temperature and the concentration. The Williamson parameter does not significantly impact radial velocity, temperature, and concentration.

Keywords: Williamson fluid, Radiation, Viscous dissipation, Exponential stretching, Similarity transformations