

Dual solutions of exponentially stretched/shrunked flows of nanofluids

ABSTRACT

An analysis is made of a steady two-dimensional boundary layer flow of a nanofluid and heat transfer over a stretching/shrinking sheet. The governing boundary layer equations are reduced into ordinary differential equations by a similarity transformation which are then solved numerically for three types of nanoparticles, namely copper (Cu), alumina (Al_2O_3), and titania (TiO_2) in the water based fluid with Prandtl number $Pr = 6.2$. The model used for the nanofluid incorporates the effect of nanoparticles volume fraction ϕ and stretching/shrinking parameter λ . The skin friction coefficient, the local Nusselt number and the velocity and temperature profiles are presented graphically and discussed. It was found that the dual solutions exist in a certain range of the suction parameter for both stretching and shrinking cases. The nanoparticle volume fraction ϕ and the types of nanoparticles play an important role to significantly determine the flow behavior. It is also found that the range of the mass suction parameter S where the similarity solution exists for the steady two-dimensional boundary flow over an exponentially stretching/shrinking sheet is larger compared with the linear stretching/shrinking sheet case.

Keyword: Boundary layer; Dual solutions; Exponentially stretching/shrinking; Heat transfer; Nanofluids