Boundary layer stagnation-point slip flow and heat transfer towards a shrinking/stretching cylinder over a permeable surface

ABSTRACT

In this paper, the boundary layer stagnation-point slip flow and heat transfer towards a shrinking/stretching cylinder over a permeable surface is considered. The governing equations are first transformed into a system of non-dimensional equations via the non-dimensional variables, and then into self-similar ordinary differential equations before they are solved numerically using the shooting method. Numerical results are obtained for the skin friction coefficient and the local Nusselt number as well as the velocity and temperature profiles for some values of the governing parameters, namely the velocity slip parameter (α), the thermal slip parameter (β), the curvature parameter (γ) and the velocity ratio parameter (c/a). The physical quantities of interest are the skin friction coefficient and the local Nusselt number measured by $f''(0)$ and $-\theta'(0)$, respectively. The numerical results show that the velocity slip parameter α increases the heat transfer rate at the surface, while the thermal slip parameter β decreases it. On the other hand, increasing the velocity slip parameter α causes the decrease in the flow velocity. Further, it is found that the solutions for a shrinking cylinder ($c/a<0$) are non-unique with dual solutions, which is different from a stretching cylinder ($c/a>0$) case. Finally, it is also found that the values of $f''(0)$ and $-\theta'(0)$ increase as the curvature parameter γ increases.

Keyword: Boundary layer; Heat transfer; Numerical solution; Shrinking/stretching cylinder; Slip flow; Stagnation-point; Suction/injection