Stability analysis on the flow and heat transfer of a nanofluid past a stretching/shrinking cylinder with suction effect

ABSTRACT

The steady boundary layer flow over a stretching/shrinking cylinder with suction effect is numerically studied. Using a similarity transformations, the governing partial differential equations are transformed into a set of nonlinear differential equations and have been solved numerically using a bvp4c code in Matlab software. The nanofluid model used is taking into account the effects of Brownian motion and thermophoresis. The influences of the governing parameters namely the curvature parameter γ, mass suction parameter S, Brownian motion parameter Nb and thermophoresis parameter Nt on the flow, heat and mass transfers characteristics are presented graphically. The numerical results obtained for the skin friction coefficient, local Nusselt number and local Sherwood number are thoroughly determined and presented graphically for several values of the governing parameters. From our investigation, it is found that the non-unique (dual) solutions exist for a certain range of mass suction parameter. It is observed that as curvature parameter increases, the skin friction coefficient and heat transfer rate decrease, meanwhile the mass transfer rates increase. Moreover, the stability analysis showed that the first solution is linearly stable, while the second solution is linearly unstable.

Keyword: Stretching/shrinking cylinder; Suction effect; Brownian motion; Thermophoresis; Stability analysis