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Stability Analysis of Three-Dimensional Flow and Heat Transfer over a Permeable Shrinking Surface in a Cu-Water Nanofluid

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Abstract : In this paper, the steady laminar three-dimensional boundary layer flow and heat transfer of a copper (Cu)-water nanofluid in the vicinity of a permeable shrinking flat surface in an otherwise quiescent fluid is studied. The nanofluid mathematical model in which the effect of the nanoparticle volume fraction is taken into account is considered. The governing nonlinear partial differential equations are transformed into a system of nonlinear ordinary differential equations using a similarity transformation which is then solved numerically using the function bvp4c from Matlab. Dual solutions (upper and lower branch solutions) are found for the similarity boundary layer equations for a certain range of the suction parameter. A stability analysis has been performed to show which branch solutions are stable and physically realizable. The numerical results for the skin friction coefficient and the local Nusselt number as well as the velocity and temperature profiles are obtained, presented and discussed in detail for a range of various governing parameters.

Keywords : heat transfer, nanofluid, shrinking surface, stability analysis, three-dimensional flow
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