Dual solutions of MHD three-dimensional flow over a permeable stretching/shrinking surface with velocity slip and thermal radiation in a nanofluid

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ABSTRACT

The magnetohydrodynamic (MHD) three-dimensional flow of alumina (Al_2O_3)-water nanofluid over a permeable stretching/shrinking surface is numerically studied. The present model is devoted to the effects of velocity slip condition and thermal radiation parameter on the fluid flow and heat transfer. The governing partial differential equations are reduced into a system of ordinary differential equations using a similarity transformation, which are then solved numerically using the Matlab routine boundary value problem solver bvp4c. Dual solutions exist for a certain range of the suction parameter. A stability analysis is performed to determine which solution is stable and physically realizable. The numerical results for the skin friction coefficient and local Nusselt number are obtained and discussed. It is found that heat transfer rate increases as the velocity slip increases but the local Nusselt number decreases when the thermal radiation increases.

KEYWORDS

Magnetohydrodynamic; Nanofluid; Stretching/shrinking surface; Thermal radiation; Three-dimensional flow; Velocity slip

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