Double solutions and stability analysis of micropolar hybrid nanofluid with thermal radiation impact on unsteady stagnation point flow

ABSTRACT

The mathematical modeling of unsteady flow of micropolar Cu–Al2O3/water nanofluid driven by a deformable sheet in stagnation region with thermal radiation effect has been explored numerically. To achieve the system of nonlinear ordinary differential equations (ODEs), we have employed some appropriate transformations and solved it numerically using MATLAB software (built-in solver called bvp4c). Influences of relevant parameters on fluid flow and heat transfer characteristic are discussed and presented in graphs. The findings expose that double solutions appear in shrinking sheet case in which eventually contributes to the analysis of stability. The stability analysis therefore confirms that merely the first solution is a stable solution. Addition of nanometer-sized particle (Cu) has been found to significantly strengthen the heat transfer rate of micropolar nanofluid. When the copper nanoparticle volume fraction increased from 0 to 0.01 (1%) in micropolar nanofluid, the heat transfer rate increased roughly to an average of 17.725%. The result also revealed that an upsurge in the unsteady and radiation parameters have been noticed to enhance the local Nusselt number of micropolar hybrid nanofluid. Meanwhile, the occurrence of material parameter conclusively decreases it.

Keyword: Micropolar hybrid nanofluid; Dual solution; Stretching/shrinking sheet; Stability analysis; Thermal radiation