Numerical analysis of double-diffusive free convection in a curvilinear cavity filled with nanofluid and triple fins attached to the hot walls

Regular Article | Published: 09 February 2024

Volume 139, article number 149, (2024) Cite this article

Mohammed Azeez Alomari, Khaled Al-Farhany ✉, Qusay H. Al-Salami, Farah Q. A. Alyousuf, I. R. Ali & Nirmalendu Biswas

Abstract

This work has numerically investigated the double diffusion of free convection in a curvilinear enclosure filled with nanoliquid and containing fins with heat generation/absorption. The considered enclosure, the curvilinear cavity, has triple fins connected to the inclined walls, which are hot and have a high intensity of solutal; however, the top wall is cold and low intensity of solutal. The bottom walls, as well as the vertical walls, are considered to be isotopically insulated. The parameters that are considered are Rayleigh (from 10^3 to 10^5), Hartmann (from 0 to 60), heat generation/absorption, q, (− 4 to 3), bouncy ratio (N = − 4 to 4), Lewis number (Le = 0.5–10), volume concentration (Φ = 0–0.06) at fixed Prandtl number. The governing equations have been numerically solved and applying the FEM technique. The important findings explain how heat and mass transfer can be improved by increasing the value of Ra, q, and Φ while decreasing with the increase in Ha. Also, the rise of the N ratio and Le number until (N = 2), where the reduction value reaches 44% from (N = − 4) to (N = 2) at (Le = 0.5), and the effect of both N and Le become negligible for (N > 2). Furthermore, the value of Sh_{avg} has the same behaviour as Nu_{avg} with N, where Sh_{avg} decreases with increasing N and increases with increasing Le, where maximum mass transfer enhancement reaches 65% at N = − 4. The effects of N and Le become negligible at N = 2.