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Numerical Approach to a Mathematical Modeling of Bioconvection Due to Gyrotactic Micro-Organisms over a Nonlinear Inclined Stretching Sheet

Authors : Madhu Aneja, Sapna Sharma

Abstract : The water-based bioconvection of a nanofluid containing motile gyrotactic micro-organisms over nonlinear inclined stretching sheet has been investigated. The governing nonlinear boundary layer equations of the model are reduced to a system of ordinary differential equations via Oberbeck-Boussinesq approximation and similarity transformations. Further, the modified set of equations with associated boundary conditions are solved using Finite Element Method. The impact of various pertinent parameters on the velocity, temperature, nanoparticles concentration, density of motile micro-organisms profiles are obtained and analyzed in details. The results show that with the increase in angle of inclination δ, velocity decreases while temperature, nanoparticles concentration, a density of motile micro-organisms increases. Additionally, the skin friction coefficient, Nusselt number, Sherwood number, density number are computed for various thermophysical parameters. It is noticed that increasing Brownian motion and thermophoresis parameter leads to an increase in temperature of fluid which results in a reduction in Nusselt number. On the contrary, Sherwood number rises with an increase in Brownian motion and thermophoresis parameter. The findings have been validated by comparing the results of special cases with existing studies.

Keywords : bioconvection, finite element method, gyrotactic micro-organisms, inclined stretching sheet, nanofluid
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