Abstract

This research presents a thorough analysis of heat and mass transfer in non-Newtonian fluids, focusing on the Oldroyd-B model. It investigates the unsteady flow of Oldroyd-B nanofluids in an arterial system, considering convective heat transfer effects. The study applies nanoparticle-enhanced magneto-hemodynamics to cryosurgery, a technique that targets cancer cells while minimizing harm to healthy tissues. The fluid dynamics model uses blood with dispersed gold nanoparticles to enhance thermal conductivity. Analytical solutions for velocity and temperature profiles are obtained using Laplace and finite Hankel transforms. The results show that increasing nanoparticle volume fraction and time parameter enhances temperature, while blood velocity is influenced by slip velocity, thermal Grashof number, and other factors. A comprehensive analysis of different parameters such as Grashof number, Prandtl number, nanoparticle volume friction parameter and Oldroyd-B fluid parameters are presented through graphs by using MATHCAD and conclude important findings. The inclusion of Au nanoparticles significantly improves tissue freezing in nano-cryosurgery, providing valuable insights for optimizing medical procedure design and effectiveness.