

The Influence of Thermal Radiation and Chemical Reaction on MHD Micropolar Fluid in The Presence of Heat Generation/Absorption

Authors : Binyam Teferi

Abstract : Numerical and theoretical analysis of mixed convection flow of magneto- hydrodynamics micropolar fluid with stretching capillary in the presence of thermal radiation, chemical reaction, viscous dissipation, and heat generation/absorption have been studied. The non-linear partial differential equations of momentum, angular velocity, energy, and concentration are converted into ordinary differential equations using similarity transformations which can be solved numerically. The dimensionless governing equations are solved by using Runge Kutta fourth and fifth order along with the shooting method. The effect of physical parameters viz., micropolar parameter, unsteadiness parameter, thermal buoyancy parameter, concentration buoyancy parameter, Hartmann number, spin gradient viscosity parameter, microinertial density parameter, thermal radiation parameter, Prandtl number, Eckert number, heat generation or absorption parameter, Schmidt number and chemical reaction parameter on flow variables viz., the velocity of the micropolar fluid, microrotation, temperature, and concentration has been analyzed and discussed graphically. MATLAB code is used to analyze numerical and theoretical facts. From the simulation study, it can be concluded that an increment of micropolar parameter, Hartmann number, unsteadiness parameter, thermal and concentration buoyancy parameter results in decrement of velocity flow of micropolar fluid; microrotation of micropolar fluid decreases with an increment of micropolar parameter, unsteadiness parameter, microinertial density parameter, and spin gradient viscosity parameter; temperature profile of micropolar fluid decreases with an increment of thermal radiation parameter, Prandtl number, micropolar parameter, unsteadiness parameter, heat absorption, and viscous dissipation parameter; concentration of micropolar fluid decreases as unsteadiness parameter, Schmidt number and chemical reaction parameter increases. Furthermore, computational values of local skin friction coefficient, local wall coupled coefficient, local Nusselt number, and local Sherwood number for different values of parameters have been investigated. In this paper, the following important results are obtained; An increment of micropolar parameter and Hartmann number results in a decrement of velocity flow of micropolar fluid. Microrotation decreases with an increment of the microinertial density parameter. Temperature decreases with an increasing value of the thermal radiation parameter and viscous dissipation parameter. Concentration decreases as the values of Schmidt number and chemical reaction parameter increases. The coefficient of local skin friction is enhanced with an increase in values of both the unsteadiness parameter and micropolar parameter. Increasing values of unsteadiness parameter and micropolar parameter results in an increment of the local couple stress. An increment of values of unsteadiness parameter and thermal radiation parameter results in an increment of the rate of heat transfer. As the values of Schmidt number and unsteadiness parameter increases, Sherwood number decreases.

Keywords : thermal radiation, chemical reaction, viscous dissipation, heat absorption/ generation, similarity transformation

Conference Title : ICCFD 2023 : International Conference on Computational Fluid Dynamics

Conference Location : Berlin, Germany

Conference Dates : May 11-12, 2023