

Thermal radiation effect on flow and heat transfer of unsteady MHD micropolar fluid over vertical heated nonisothermal stretching surface using group analysis*

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Abstract The aim of this paper is to study the thermal radiation effects on the flow and heat transfer of an unsteady magnetohydrodynamic (MHD) micropolar fluid over a vertical heated nonisothermal stretching surface in the presence of a strong nonuniform magnetic field. The symmetries of the governing partial differential equations are determined by the two-parameter group method. One of the resulting systems of reduced nonlinear ordinary differential equations are solved numerically by the Chebyshev spectral method. The effects of various parameters on the velocity, the angular velocity, and the temperature profiles as well as the skin-friction coefficient, the wall couple stress coefficient, and the Nusselt number are studied.

Key words thermal radiation, micropolar fluid, unsteady flow, group theoretic method, Chebyshev spectral method

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Nomenclature

B ,	applied magnetic field;	I ,	dimensionless angular velocity;
T_c ,	characteristic temperature;	ξ ,	ratio of the gyration vector component to the fluid shear at a solid boundary;
C_f ,	skin-friction coefficient;	j ,	microinertia density;
t ,	time;	K ,	material parameter;
c_p ,	specific heat at constant pressure;	β ,	thermal expansion coefficient;
U_0 ,	characteristic velocity;	K_λ ,	absorption coefficient;
$e_{b\lambda}$,	Planck's function;	κ ,	thermal conductivity;
u, v ,	velocities along the x - and y -axes;	L ,	characteristic length;
Re ,	Reynolds number;	ν ,	kinematic viscosity;
r ,	radiation parameter;	M ,	magnetic parameter;
Pr ,	Prandtl number;	ρ ,	fluid density;
T ,	dimensional temperature;	m_w ,	wall couple stress;
f ,	dimensionless stream function;	γ_0 ,	spin gradient viscosity;
(x, y) ,	Cartesian coordinate;	m_0 ,	microrotation parameter;
g ,	gravitational acceleration;		

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