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Impact of generalized Fourier's law and Fick's law for MHD flow of Ag–H_2O and TiO_2–H_2O nanomaterials

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Abstract

Purpose – The purpose of this paper is to investigate the effect of inclined magnetic field, variable viscosity and Cattaneo–Christov heat and mass flux theories on the steady MHD free convective boundary layer flow of viscous, incompressible and electrically conducting water-driven silver and titanium-oxide nanofluids over a vertical stretching sheet.

Design/methodology/approach – The boundary layer equations of momentum, energy and nanoparticle concentration are partial differential equations in nature, which are reduced to nonlinear ordinary differential equations by means of similarity transformations. The resulting nonlinear equations are solved analytically by means of optimal homotopy analysis method.

Findings – Assessments with numerical results are performed and are found to be in an excellent agreement. Numerical results of the skin friction factor, the local Nusselt number and the local Sherwood number are obtained through tables. The effects of various physical parameters on the velocity, temperature and nanoparticles fraction are incorporated through graphs. The study analyzes the efficiency of heat transfer of nanofluids in cooling plants and rubber sheets.

Originality/value – No research works have been conducted to evaluate the effects of various physical phenomena on the copper and titanium nanofluids flow.

Keywords Heat and mass transfer, OHAM, Inclined magnetic field, Ag and TiO_2 nanoparticles, Cattaneo–Christov model

Paper type Research paper

Nomenclature

u, v	components of velocity in x and y directions (m/s)
x	coordinate along the stretching sheet (m)
y	distance normal to the stretching sheet (m)
u_w	stretching sheet velocity (m/s)
C_f	skin friction coefficient
c_p	specific heat at constant pressure (N/m^2)
C	nanoparticles volume fraction
D_B	Brownian diffusion coefficient (m^2/s)
D_T	thermophoresis diffusion coefficient (m^2/s)
B_0	magnetic field strength (A/m)
M	magnetic parameter
N_b	Brownian motion parameter
N_t	thermophoresis parameter
Re	Reynolds's number

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