A new Caputo time fractional model for heat transfer enhancement of water based graphene nanofluid: An application to solar energy

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ABSTRACT

In this article the idea of Caputo time fractional derivatives is applied to MHD mixed convection Poiseuille flow of nanofluids with graphene nanoparticles in a vertical channel. The applications of nanofluids in solar energy are argued for various solar thermal systems. It is argued in the article that using nanofluids is an alternate source to produce solar energy in thermal engineering and solar energy devices in industries. The problem is modelled in terms of PDE's with initial and boundary conditions and solved analytically via Laplace transform method. The obtained solutions for velocity, temperature and concentration are expressed in terms of Wright's function. These solutions are significantly controlled by the variations of parameters including thermal Grashof number, Solutal Grashof number and nanoparticles volume fraction. Expressions for skin-friction, Nusselt and Sherwood numbers are also determined on left and right walls of the vertical channel with important numerical results in tabular form. It is found that rate of heat transfer increases with increasing nanoparticles volume fraction and Caputo time fractional parameters.

KEYWORDS:

Graphene nanoparticles; Caputo time fractional model; Poiseuille flow; Heat and mass transfer; Nusselt number; Solar energy; Exact solution