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Application of fractional derivative without singular and local kernel to enhanced heat transfer in CNTs nanofluid over an inclined plate

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Abstract

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Nanofluids are a novel class of heat transfer fluid that plays a vital role in industries. In mathematical investigations, these fluids are modeled in terms of traditional integer-order partial differential equations (PDEs). It is recognized that traditional PDEs cannot decode the complex behavior of physical flow parameters and memory effects. Therefore, this article intends to study the mixed convection heat transfer in nanofluid over an inclined vertical plate via fractional derivatives approach. The problem in hand is modeled in connection with Atangana-Baleanu fractional derivatives without singular and local kernel with a strong memory. Human blood is considered as base fluid and carbon nanotube (CNTs) (single-wall carbon nanotubes (SWCNTs) and multi-wall carbon nanotubes (MWCNTs) are dispersed into it to form blood-CNTs nanofluid. The nanofluid is considered to flow in a saturated porous medium under the influence of an applied magnetic field. The exact analytical expressions for velocity and temperature profiles are acquired using the Laplace transform technique and plotted in various graphs. The empirical results indicate that the memory effect decreases with increasing fractional parameters in the case of both temperature and velocity profiles. Moreover, the temperature profile is higher for blood SWCNTs because of higher thermal conductivity whereas this trend is found opposite in the case of velocity profile due to densities difference. © 2020 by the authors.

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