MHD Casson Fluid with Radiative Heat and Mass Transfer past an Impulsively Moving Inclined Plate

OSMAN, H. I.[1], ISMAIL, Z.[1], SAMAH, R. A.[2], VIERU, D.[3]
[1]Centre for Mathematical Sciences,
Universiti Malaysia Pahang Al-Sultan Abdullah,
Lebuh Persiaran Tun Khalil Yaakob, 26300 Kuantan, Pahang,
MALAYSIA

[2]Faculty of Chemical and Process Engineering Technology,
Universiti Malaysia Pahang Al- Sultan Abdullah,
Lebuh Persiaran Tun Khalil Yaakob, 26300 Kuantan, Pahang,
MALAYSIA

[3]Department of Theoritical Mechanics (MT),
Georgia Asachi Technical University of lasi TU lasi,
ROMANIA

Abstract: - This paper explores the flow of Casson fluid that passes a moving inclined plate with the influence of double diffusions and radiation, where the fluid is imposed electrically conductive and moves through a porous medium. Several suitable non-dimensional variables are suggested in the model using partial differential equations with initial and boundary conditions. The corresponding non-dimensional governing equations are solved with the help of Laplace transform method. Analytical solutions to momentum, energy, and concentration are obtained, and the expression is in exponential and complementary error functions of Gauss. Finding solutions is limited to similar solutions for previous studies on Casson and viscous fluids as a special case. Computations are performed, where the outcomes are examined for embedded flow parameters.

Key-Words: - Casson fluid, radiation, heat and mass transfer, Laplace transform, MHD, inclined plate, porous medium.

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1 Introduction

In recent years, non-Newtonian fluids have been viewed as a more appropriate technique for scientific and technological applications than Newtonian fluids. In contrast to Newtonian fluids, non-Newtonian fluids are not only seen in natural phenomena such as avalanches and mudslides, but also in real-life technologies. Its applications are implemented across a diverse range of industrial sectors due to their vital applications areas, such as biological substances, chemicals food products, personal care items, and more. The automotive industry is one of the applications that widely use the benefit of non-Newtonian fluid studies. For example, the shock absorbers and dampers viscosity are controlled by the magnetic field, and the high shear rates generated by turbulent flow cause the fluid to thicken and provide significant damping forces when needed. Consequently, scientists are intrigued by a complicated area of non-Newtonian fluids, particularly Casson fluid. [1], numerically analyzed the behavior of free convection Casson fluid in a square porous cavity. [2], examined how chemical reactions, heat sources, and temperature gradients influence MHD Casson fluid flow on a flat surface in the Forschimmer medium. The heat transport via non-Newtonian fluids in different geometrics employing efficient methods has attracted the attention of the scientific community, [3], [4], [5], [6].

Magnetohydrodynamics (MHD) finds application in various fluid flow scenarios and boasts a diverse range of uses, encompassing fields such as medicine, oil industry operations, aviation, MHD power generation, nuclear reactors, and even astronomy. [7], studied the effect of MHD natural convection flow of nanofluids with ramped wall velocity and temperature on the dependent time t,