UNIVERSITI TEKNOLOGI MARA

MHD BOUNDARY LAYER FLOW OF CASSON FLUID UNDER THE INFLUENCES OF RADIATION ON MASS TRANSFER AND EXPONENTIALLY STRETCHING SHEET WITH HEAT SINK

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ABSTRACT

Casson fluid which is characterised by the non-Newtonian fluid behaviour is applicable in various industrial processes which include polymer and metal extrusion, wire drawing and paper production process. In this study, MHD boundary layer flow of Casson fluid over an exponentially stretching sheet with heat sink is anylysed. The study is an extrusion of the work done by Devi et al. (2014) and Pramanik (2014). It involves modification of the momentum equation is the system of partial differential equation. The governing system of partial differential equation is the transformed into a system of ordinary differential equations. The system of ordinary differential equation is then solved numerically using the Runge-Kutta-Fehlberg method in using MAPLE 15 environment. The numerical results of momentum, temperature and concentration profiles are presented graphically for various parameters such as magnetic parameter M, heat sink parameter Q, radiation parameter R, Schmidt number Sc, Prandtl number Pr and Casson parameter β. The numerical values for skin friction coefficient, local Nusselt number and local Sherwood number are tabulated and discussed. It is found that as the magnetic and Casson parameter are increased, the temperature and concentration profiles also increased. It is also found that an increase in radiation parameter and heat sink parameter result an increase in thermal boundary layer thickness.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF STUDY

A boundary layer is an important concept in physics and fluid mechanics which refers to the layer of fluid in the immediate vicinity of a bounding surface where the effects of viscosity are significant. The boundary layers can be defined as the condition of zero fluid momentum at the solid surface by assuming the no slip condition and layer of fluid between the surface and free stream fluid. The idea of the boundary layer was introduced by Prandtl in 1904. He said the thickness of fluids plays a role in a thin layer nearby the surface which is called "boundary layer" (Tani, 1977). There is no significant change across the boundary layer because it implies the pressure is the same as in the inviscid flow outside the boundary layer (Welty et al., 2007).

The Casson fluid or non-Newtonian fluid of constitutive equation which is a relationship between the shear stress and yield stress is defined as the momentum of blood in the axial direction. Where else the viscosity of Newtonian fluid remains constant, no matter the amount of shear applied for a constant temperature. The Newtonian fluid such as water, gasoline and mineral oil has a linear relationship between viscosity and shear stress. Casson fluid also can be defined as a shear thinning liquid which is assumed to have an infinite viscosity at zero rate of shear, a yield stress below which no flow occurs and a zero viscosity at an infinite rate of shear (Dash & Mehta, 1996). Therefore, if a shear stress less than a yield stress is applied to the fluid, it behaves like solid. If a shear stress greater than a yield stress is applied, it starts to move such as jelly, tomato source, honey, soup, shampoos, concentrated fruit juices and human blood. Rao et al. (2015) found Casson fluid model is diminished to a Newtonian fluid at a higher wall shear stress where the wall stress is greater than yield stress.