MAGNETOHYDRODYNAMIC BIOCONVECTION FLOW OF WALTER'S – B NANOFLUID OVER AN EXPONENTIALLY STRETCHING SURFACE

AZIZ MOHAMED KIPOLELO (BSc. Ed)

I56EA/20754/2021

A Research Project Submitted in Partial Fulfilment of the Requirements for the Award of the Degree of Master of Science (Applied Mathematics) in the School of Pure and Applied Sciences of Kenyatta University

May, 2024.

Declaration

Declaration by the Candidate

This project is my original work and has not been submitted for any award of a degree in any University.

Name: Aziz Mohamed Kipolelo

Signature: ..... Date: 03/06/2024

Declaration by the Supervisor

This project has been submitted for examination with my approval as the University

Name: Dr. Winifred N. Mutuku

Signature: ..... Date: 04/06/2024.

Department of Mathematics and Actuarial Science, Kenyatta University

Abstract

Magnetohydrodynamics Bioconvection flow of Walter's – B nanofluid is one among the many research areas that have captured the attention of most scientists to investigate and study its application in this technologically evolving and developing world. The occurrence of gyrotactic microorganisms in MHD Bioconvection flow of Walter's – B nanofluid containing nanomaterials is applicable in the creation of bioenergy, synthesis of biological polymers, production of refined microorganism petroleum, biodiesel fuel, biofuel, drug production in pharmaceutical companies, drug delivery devices, the production of ethanol, biofertilizers and bioactive secondary metabolite and also is friendly to environmental and ecological systems. This study is conducted to explore the bioconvection induced by the Magnetohydrodynamics in an entirely two-dimensional, steady, incompressible flow of Walter's – B nanofluid in the presence of nanomaterials and gyrotactic microorganisms over an exponentially stretching surface. The Buongiorno model together with the Boussinesq approximation is adopted and taking into account the effects of Brownian motion and thermophoresis, the governing equations of the flow are formulated and transformed to their dimensionless forms using similarity transformations. The resulting first-order ordinary differential equations are numerically solved using the Shooting Technique together with the fourth-order Runge-Kutta method. Simulation of the model and investigation of the effects of pertinent parameters on the fluids' temperature, velocity, nanomaterial concentration and dimensionless motile microorganism density is carried out using MATLAB bvp4c. It is observed that the velocity field is boosted with Weissenberg number, Brownian motion parameter and Grashof number but reduced with Buoyancy ratio parameter and Thermophoretic parameter. The temperature profiles increased with Brinkman number and Hartmann number nevertheless, the Prandtl number has the opposite effect. The nanomaterial concentration and motile microorganisms' density profiles increased subject to Buoyancy ratio parameter, however, Bioconvection Peclet number and Bioconvection Lewis parameter have bi-influence toward motile microorganisms' density profile.