



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



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التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



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Solutions of some problems of Nanofluids flow with heat and mass transfer under external forces

A Thesis

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Arabic Summary

SUMMARY

The study of the non-Newtonian nanofluids flow is playing an important role in fluid mechanics, where it has different applications such as electronics, chemicals, biomedicine, food, and industrial applications. The study of some problems of nanofluids flow under the effect of various physical parameters is very important in governing the velocity, temperature, concentration of nanoparticles, and concentration of microorganisms.

The main aim of this thesis is to solve some problems of non-Newtonian nanofluids flow with heat and mass transfer under the action of the external forces. These problems are described by a system of nonlinear partial differential equations with suitable boundary conditions, these equations are solved numerically by using the Mathematica program.

The thesis consists of four chapters as follows:

Chapter 1

This chapter contains a general introduction as follows:

- 1.1 Fluid mechanics
- 1.2 Newtonian and non-Newtonian
- 1.3 Boundary layer
- 1.4 Nanofluids
- 1.5 Microorganisms
- 1.6 Magnetohydrodynamic
- 1.7 Heat transfer
- 1.8 Mass transfer
- 1.9 Porous medium
- 1.10 Governing equations
- 1.11 Dimensionless parameters
- 1.12 Method of solution

Chapter 2

In this chapter, we discussed the problem of the boundary layer flow of a non-Newtonian nanofluid containing gyrotactic microorganisms with heat and mass transfer. The effect of the Navier slip on the bioconvection flow is considered. The system is stressed by an external uniform magnetic field. This problem is modulated mathematically by a system of partial differential equations that describe the motion with heat and mass transfer. The governing equations are converted to non-linear ordinary differential equations by using suitable transformations. This system with appropriate boundary conditions is solved analytically by using the homotopy perturbation method. The effects of the different parameters on the velocity, temperature, concentration of nanofluids and concentration of motile microorganisms are discussed numerically and graphically. Also, the reduced

Nusselt number, Sherwood number, and density number of motile microorganisms are examined and presented graphically. Through a set of figures, it clear that the physical parameters of the problem play an important role in the obtained solutions.

Chapter 3

In this chapter, the effects of thermal diffusion and diffusion thermo on the motion of non-Newtonian Eyring Powell nanofluid with gyrotactic microorganisms in the boundary layer are investigated. The system is stressed by a uniform external magnetic field. The problem is modulated mathematically by a system of nonlinear partial differential equation, which governs the equations of motion, temperature, the concentration of Solute, nanoparticles, and microorganisms. This system is converted to the nonlinear ordinary differential equations by using suitable similarity transformations with appropriate boundary conditions. These equations are solved numerically by using the Rung-Kutta-Merson method with a shooting technique. The velocity, temperature, the concentration of Solute, nanoparticles, and microorganisms are obtained as functions of the physical parameters of the problem. The effects of these parameters on these solutions are discussed numerically and illustrated graphically through some figures. It is found that these parameters play an important role and help in understanding the mechanics of some complicated physiological flows.

Chapter 4

In this chapter, the effect of the induced magnetic field on the motion of Eyring-Powell nanofluid containing gyrotactic microorganisms through the boundary layer is investigated. The viscoelastic dissipation is taken into consideration. The system is stressed by an external magnetic field. The continuity, momentum, the induced magnetic field, temperature, concentration and microorganisms' equations that describe our problem are written in the form of two-dimensional nonlinear differential equations. The system of nonlinear partial differential equations is transformed into ordinary differential equations using appropriate similarity transformations and solved numerically with suitable boundary conditions. The effects of Brownian motion, thermophoresis, and other parameters are taking into account. The obtained numerical results for velocity, induced magnetic field, temperature, the concentration of nanoparticles and microorganisms are discussed and presented graphically through some figures. The physical parameters of the problem play an important role to control the obtained solutions.

Chapter 1

Introduction

Chapter 1

Introduction

The main topics in this chapter:

- 1.1) Fluid mechanics
- 1.2) Newtonian and non-Newtonian
- 1.3) Boundary layer
- 1.4) Nanofluids
- 1.5) Microorganisms
- 1.6) Magnetohydrodynamic
- 1.7) Heat transfer
- 1.8) Mass transfer
- 1.9) Porous medium
- 1.10) Governing equations
- 1.11) Dimensionless parameters
- 1.12) Method of solution

These topics are discussed in detail.

1.1 Fluid mechanics

A fluid is defined as a substance that deforms continuously when acted upon by shearing stress of any magnitude. Fluid mechanics is the study of fluids at rest (fluid statics) and fluids in motion (fluid dynamics). In fluid mechanics, both liquids and gases are considered to be fluids. Some applications in fluid mechanics including civil, chemical and biomedical engineering and biology [1].

1.2 Newtonian and non-Newtonian fluids

1.2.1 Newtonian fluids

A fluid whose viscosity does not change with the rate of flow. The flow behavior of fluids with a simple linear relation between shear stress and shear rate. This relationship is known as Newton's law of viscosity, where the proportionality constant η is the viscosity of the fluid [2].

$$\tau = \eta \dot{\gamma} \quad (1.1)$$

Where τ the shear stress, η the viscosity, and $\dot{\gamma}$ the shear rate.

Newtonian fluids include water, organic solvents and, honey. For those fluids, viscosity is only dependent on temperature.

1.2.2 Non-Newtonian fluid

It is defined as a fluid whose viscosity is variable based on applied stress or force. The most common example is cornstarch dissolved in water. The physical pressure of non-Newtonian fluid depends on the forces acting on it.

Many polymer solutions and molten polymers are non-Newtonian fluids such as ketchup, paint and, shampoo. In a non-Newtonian fluid, the relation between the shear stress and the strain rate is nonlinear and can even be time dependent.

i) Types of non-Newtonian fluid:

1) Time-independent non-Newtonian fluids:

- a) Shear-thinning: viscosity decreases with increased stress. Such as tomato sauce, cream and wet sand.
- b) Dilatant or shear thickening: viscosity increases with increased stress. Such as oobleck.
- c) Visco-plastics: fluids that have a linear shear stress or shear strain relationship require a finite yield stress before they begin to flow. Such clay suspensions, toothpaste, mayonnaise, chocolate, and mustard.
- d) Generalized Newtonian fluids: viscosity is constant. Stress depends on normal and shear strain rates, and the pressure applied on it. Such as blood plasma and custard.

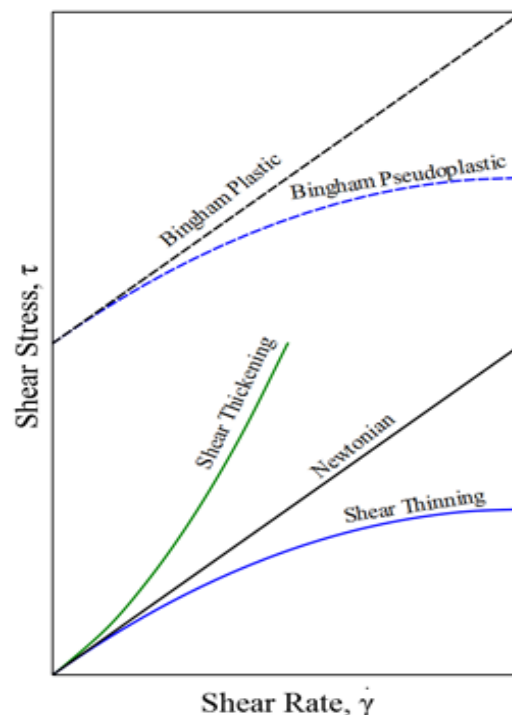


Fig. 1.1 Flow curves of time-independent fluids