

Effect of Hall Current in Oscillatory Flow of a Couple Stress Fluid in an Inclined Channel

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Abstract. The effects of Hall current on oscillatory flow of a couple stress fluid in an inclined channel of blood has been considered. The closed form solutions for the velocity, temperature and concentration fields are obtained analytically and then evaluated numerically for different values of parameters using *Mathematica*, appearing in these equations. To have a better insight of the problem the variations of the physical quantities with flow parameters are shown graphically. By introducing a critical Magnetic field, the limit for Magnetic field with Hall current is also discussed.

Keywords: Hall current, oscillatory flow, couple stress fluid, MHD, inclined channel.

AMS Mathematics Subject Classification (2010): 76S05, 76W05

Nomenclatures:

B_o	External magnetic field		concentration
g	Gravitational acceleration	u	Axial velocity
Gr	Grashof number	(x,y)	Space coordinates
Gc	Modified Grashof number	α	Angle of inclination
H	Hartmann number	C_p	Specific heat at a constant pressure
K	Permeability factor	β	Coefficient of volume expansion due to temperature
N	Thermal radiation parameter	η	Coefficient of couple stress
Nu	Nusselt number	γ	Couple stress parameter
p	Pressure	μ	Dynamic viscosity
Pe	Peclet number	ν	Kinematic viscosity
q	Radiative heat flux	σ	Conductivity of the medium
Re	Reynolds number	ω	Angular frequency
k	Thermal conductivity		
t	Time		
T, C	Fluid temperature and		

MHD Transport Phenomena of Oscillatory Channel of Blood Flow with Hall Current

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Abstract: In this paper, a model has been developed to the impact of Hall current in the transport phenomena of MHD oscillatory channel of blood flow in the presence of chemical reaction and an external magnetic field with porous medium. On the basis of certain simplifying assumptions, the fluid equations of continuity, momentum, energy and concentration are obtained. The partial differential equations governing the flow have been solved analytically and also the results are displayed graphically to illustrate the effect of various parameters on the dimensionless velocity, temperature and concentration profiles.

Keywords: Hall current, MHD, oscillatory flow, chemical reaction, porous medium.

Nomenclature

B_0 intensity of the external magnetic field
 C Concentration
 C_p specific heat at constant pressure
 g gravitational acceleration
 G_c modified Grashof number
 G_r Grashof number
 k permeability factor
 K_c chemical reaction parameter
 M Hartmann number
 N thermal radiation parameter
 N_u Nusselt number
 p^* pressure
 Pe Peclet number
 q_r Radiative heat flux
 Re Reynolds number
 β_0 Limiting viscosity
 Sh Sherwood number

S_c Schmidt number
 T^* time
 T fluid temperature
 u^* axial velocity
 (x^*, y^*) space coordinates
 β_0 viscoelastic coefficient
 β coefficient of volume expansion due to temperature
 λ slip parameter
 μ dynamic viscosity
 ν kinematic viscosity
 σ conductivity of the medium
 ω^* angular frequency
 ρ fluid density
 m hall current effect
 β_c coefficient of volume expansion due to concentrate

I. INTRODUCTION

The different rates of biochemical reactions that are responsible for the contraction of muscles, secretion of different materials such as insulin, mucus and stomach acid by the glands and the transmission of massages by the nerves can be accelerated / decelerated by the action of drugs. The performance of kidney cells and the regulation of the volume of water / salts in the body is affected by rate of drugs. The application of drugs in which blood flows through arteries can also be enhanced / slowed down by the application of drugs. It may, however, be observed that the damaged structures / functions can only be repaired by drugs, but their restoration is not possible. When the clinician treat patients suffering from various types of degenerative / tissue-destroying diseases, they observe the multiple atherosclerosis (narrowing of arterial lumen due to deposition of different fatty substances, cholesterol, etc.), arthritis, Alzheimer disease, Parkinson disease, heart failure. When the damage takes place due to some infection some drugs (e.g. antibiotics) that help the body in the damage repair process. Several drugs (antacids, for example) produce effects, where the function of a cell remains unchanged and a receptor dose not have any cognition. Most of the antacids are functioning on bases that interact with stomach acid to neutralize it. Thus stomach acid is reduced simply through chemical reactions.

MHD Peristaltic Transport of Couple Stress Fluid in an Inclined Channel with Hall Current and Slip Flow

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Abstract. This paper describes the impact of the Hall current on MHD flow of a couple stress fluid in an inclined channel. The fluid is electrically conducting through a porous medium in the presence of uniform magnetic field. The system of governing partial differential equations are solved analytically. The analytical solution is carried out under long wave length and low Reynolds number. Closed form expression for velocity, pressure gradient and pressure rise are presented. Important results reflecting the influence of embedded parameters in the problem have been pointed by plotting the graphs and discussed in detail.

Keywords: Hall current, MHD, peristaltic flow, couple stress fluid, inclined channel.

AMS Mathematics Subject Classification (2010): 76S05, 76Z05

1. Introduction

It is well established fact that peristaltic process is a mechanism for mixing and transporting fluids, which is caused by a progressive wave of contraction and expansion travelling on the walls of the channel/tube. Such process is encountered in the transport of urine from kidney to bladder, swallowing of food through esophagus, lymph transport in the lymphatic vessels and in vasomotion of small blood vessels such as arterioles, venules and capillaries etc. Roller and finger pumps also work under the peristaltic mechanism. Beginning with the first investigation of Latham [8], several theoretical and experimental attempts have been made to understand peristaltic action in different situation. Shapiro et al., [13] discussed the theoretical results for both plane and axisymmetric geometries. This has attracted several investigators to study the peristaltic transport under long wavelength and low Reynolds number.

Mekheimer [9] analysed the MHD flow of a conducting couple stress fluid in a slit channel with rhythmically contracting walls. Nirmala et al. [10] contributed the hall

Influence of Hall current in the MHD Oscillatory flow of Nanofluid: Application to the Blood flow

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Abstract: In this study, we analyse the influence of hall current in the MHD oscillatory flow of blood carrying gold nanoparticle in a porous space with radiation is investigated. We consider blood as base fluid which is Non-Newtonian and gold (Au) as nanoparticle. Therefore the nanofluid is called blood-gold nanofluid. The governing boundary layer equations are solved analytically. Numerical solutions of these equations are obtained by using the software MATHEMATICA. The influence of various parameters on the flow field, heat transfer characteristics, skin friction and Nusselt number are discussed and presented through graphs using ORIGIN software and tables. It is found that the velocity of nanofluid decreases for a given increase of nanoparticle volume fraction. Further, the rate of heat transfer increases with increasing nanoparticle volume fraction at the upper wall.

Keywords: MHD, oscillatory flow, hall current, gold nanoparticle.

INTRODUCTION

Studies pertaining to the non-Newtonian fluids are important because of its applications in biological sciences and

industry such as flow of blood, food mixing and cyme movement in the intestine, paint, polymer solutions, flow of nuclear fuel slurries and flow liquid metal and alloys. Misra et al. (2011) analysed the Hydromagnetic flow and heat transfer of a second-grade viscoelastic fluid in a channel with oscillatory stretching wall. Nirmala et al. (2018) presented MHD transport phenomena of oscillatory channel of blood flow with hall current.

Nanofluid is a mixture of nano-sized particles suspended in a base fluid, is used to enhance the rate of heat transfer through its higher thermal conductivity compared to the base fluid. Nanofluids play vital role to significantly influences the heat transfer rates in many areas such as industrial cooling applications, nuclear reactors, transportation industry, micro-electromechanical systems, heat exchangers, chemical catalytic reactors, fiber and granular insulation, packed beds, petroleum reservoirs and nuclear waste repositories and biomedical applications. Choi (1995) introduced the concept of nanofluid by immersing the nano meter sized particles into base fluids and he found the enhanced thermal conductivity in the base fluid due to the mixture of nanoparticles. Buongiorno (2006) has given clear description on convective heat transfer in nanofluids.

Das et al. (2007) written a book entitled "nanofluids science and technology", where they discussed the applications of nanofluids along with importance of convectional

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