UNSTEADY MHD FLOW OF A VISCOELASTIC FLUID THROUGH A POROUS MEDIUM WITH THE EFFECT OF MASS TRANSFER AND HALL CURRENT

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Abstract In this paper, we investigate the effect of unsteady MHD oscillatory flow of a viscoelastic fluid through the porous medium with the effect of mass transfer and hall current. The viscous incompressible and electrically conducting viscoelastic fluid through a porous medium over the finite plate with temperature and mass transfer are considered and the closed form of analytical solution are obtained for the Momentum,Energy and Concentration equation. The influence of assorted flow parameters like the thermal Grashof number, mass Grashof number, Schmidt number, Prandtl number, Hartmann number, Hall parameter, and the Viscoelastic parameter on the velocity,temperature and concentration distributions, the coefficient of Skin friction, Nusselt number and Sherwood number are obtained and their behaviour are discussed graphically.
Keywords: MHD oscillatory flow, Porous medium, Heat transfer, Thermal Radiation, Hall current.

1.INTRODUCTION

Magnetohydrodynamics (MHD) is a field of study which combines elements of electromagnetism and fluid mechanics to describe the flow of electrically conducting fluids. It is generally regarded as a difficult academic discipline, both conceptually as well as mechanically. MHD is the study of electrically conducting fluids, combining both principles of fluid dynamics and electromagnetism. Magnetohydrodynamics is that the study of the magnetic properties of electrically conducting fluids. When a conducting fluid moves through a field of force, an electric field, may be induced and, in turn the current interacts with the magnetic field to produce a body force. The science which deals with this phenomenon is called Magnetohydrodynamics.
The subject of MHD is traditionally studied as a continuum theory, that is to say, attempts at studying discrete particles in the flows are not at a level such that computation in these regards is realistic. To run realistic simulations would require computations of flows with many more particles than current computers are able to handle. Aboeldahab and Elbardy (2001) studied the Hall current effect on Magnetohydrodynamics free convection flow past a semi infinite vertical plate with mass transfer.Magnetohydrodynamics (MHD) is a field of study which combines elements of electromagnetism and fluid mechanics to describe the flow of electrically conducting fluids. It is generally regarded as a difficult academic discipline, both conceptually as well as mechanically. MHD is the study of electrically conducting fluids, combining both principles of fluid dynamics and electromagnetism. Magnetohydrodynamics is the study of the magnetic properties of electrically conducting fluids. When a conducting fluid moves through a magnetic field, an electric field, may be induced and, in turn the current interacts with the magnetic field to produce a body force.
When the strength of the magnetic field is strong one cannot neglect the effects of Hall currents. It is of significant importance and interest to review however the results of the hydrodynamical issues get changed by the consequences of Hall current. In Fluid dynamics, Hall current attains widespread

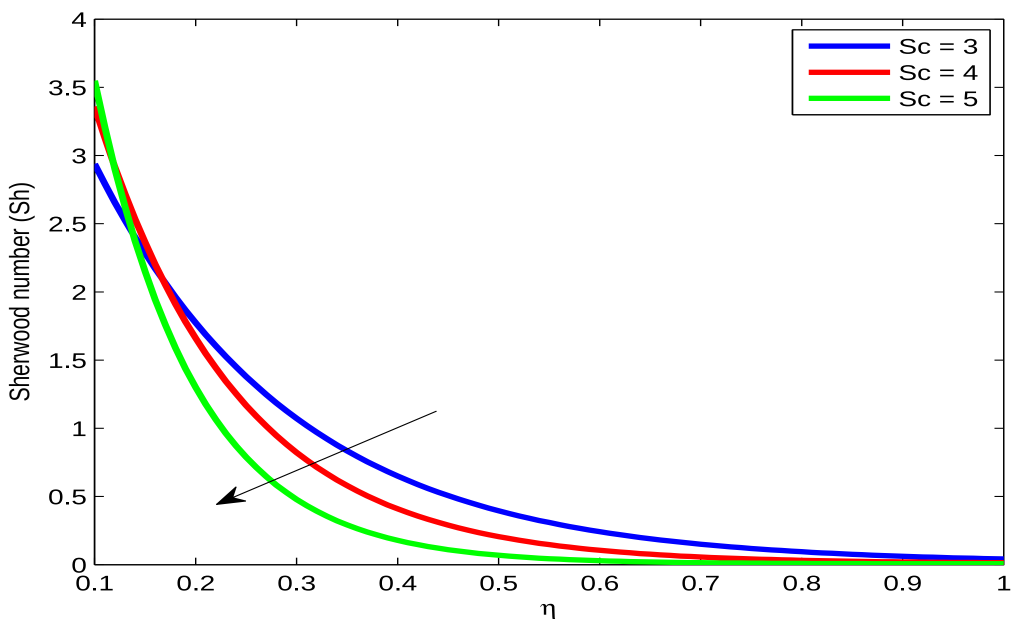

Figure 14: Variation of Sherwood number (Sh) for differnt values of Schmidt number(Sc) for fixed $\omega = 1$

Appendix

$$m_1 = \frac{-Sc + \sqrt{(Sc)^2 + i\omega Sc}}{2}$$
$$m_2 = \frac{-Sc - \sqrt{(Sc)^2 + i\omega Sc}}{2}$$
$$m_3 = \frac{-Pr + \sqrt{(Sc)^2 + i\omega Pr}}{2}$$
$$m_4 = \frac{-Pr - \sqrt{(Sc)^2 + i\omega Pr}}{2}$$
$$m_5 = \frac{-P + \sqrt{P^2 + 4P_3}}{2}$$
$$m_6 = \frac{-P - \sqrt{P^2 + 4P_3}}{2}$$
$$D_1 = \frac{PGrA_3e^{m_3\eta}}{m_3^2 + Pm_3 - P_3}$$
$$D_2 = \frac{PGrA_4e^{m_4\eta}}{m_4^2 + Pm_4 - P_3}$$
$$D_3 = \frac{PGcA_1e^{m_1\eta}}{m_1^2 + Pm_1 - P_3}$$
$$D_4 = \frac{PGcA_2e^{m_2\eta}}{m_2^2 + Pm_2 - P_3}$$
$$A_1 = \frac{m_2}{m_2e^{m_1} - m_1e^{m_2}}$$
$$A_2 = \frac{-m_1}{m_2e^{m_1} - m_1e^{m_2}}$$
$$A_3 = \frac{-m_3}{m_4e^{m_3} - m_3e^{m_4}}$$
$$A_4 = \frac{m_4}{m_4e^{m_3} - m_3e^{m_4}}$$
$$A_5 = \frac{(A_6m_6 + D_3m_3 + D_4m_4 + D_1m_1 + D_2m_2)}{m_5}$$
$$A_6 = \frac{\begin{aligned}\{D_3(m_5e^{m_3}(1-\lambda m_3) - m_3e^{m_5}(1-\lambda m_5)) + D_4(m_5e^{m_4}(1-\lambda m_4)\\ - m_4e^{m_5}(1-\lambda m_5)) + D_1(m_5e^{m_1}(1-\lambda m_1) - m_1e^{m_5}(1-\lambda m_5))\\ + D_2(m_5e^{m_2}(1-\lambda m_2) - m_2e^{m_5}(1-\lambda m_5))\}\end{aligned}}{[m_6e^{m_5}(1-\lambda m_5) - m_5e^{m_6}(1-\lambda m_6)]}$$

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