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HEAT SOURCE AND CHEMICAL REACTION EFFECTS ON UNSTEADY MHD FLOW PAST AN IMPULSIVELY STARTED OSCILLATING INCLINED PLATE WITH VARIABLE TEMPERATURE AND MASS DIFFUSION IN THE PRESENCE OF HALL CURRENT

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ABSTRACT
An attempt has been made to investigate the effects of chemical reaction on an unsteady MHD flow past an impulsively started oscillating inclined plate with variable temperature and mass diffusion in the presence of Hall current and Heat source. The dimensionless governing equations are solved numerically using Laplace transform technique. The profiles of velocity, temperature, concentration are discussed with the help of graphs for different parameters like Grashof number, Prandtl number, Schmidt number, Chemical reaction parameter, Heat source parameter ,Hall current parameter, Magnetic field parameter.

Keywords: MHD flows, Oscillating inclined plate, Variable Temperature, Mass diffusion, Hall current, Heat Source and Chemical reaction.

I. INTRODUCTION
MHD viscous flows with Hall currents have grown considerably because of its engineering applications to problems of MHD generators, Hall accelerators, as well as magneto hydrodynamics. It is also important in solar physics involved in the sunspot development, the solar cycle and the structure of magnetic stars. The effect of Hall current in the fluid flow with variable concentration has many applications in MHD power generation, in several astrophysical and meteorological studies as well as in plasma flow through MHD power generator. Sundalgekar et.al.,[1] gave an exact solution of the MHD flow of an incompressiable, electrically conducting, viscous fluid past a uniformly accelerated infinite plate. Gupta and Gupta[2] investigated hall effects on the hydromagnetic flow past an oscillating flat plate in the presence of a uniform magnetic field.AbdusSattar and AhamudAlam [3] analysed an unsteady MHD free convective heat and mass transfer flow with Hall current of electrically conducting incompressible viscous fluid through a porous medium along an infinite vertical porous plate by taking constant heat flux at the plate. Aboledahab and Elbarbary [4] studied heat and mass transfer along a vertical plate under the combined buoyancy force effects of thermal and spices diffusion in the presence of a transversely applied uniform magnetic field and the hall currents are taken into account. Stanford shateyi et.al.,[5] investigated the influence of a magnetic field on heat and mass transfer by mixed convection from vertical surfaces in the presence of Hall, radiation, Soret and Dufoureffects. Sarkar et.al.,[6] investigated the Hall effects on an unsteady MHD free convective flow of a viscous incompressible electrically conducting fluid past a uniformly accelerated vertical plate in the presence of a uniform transverse applied magnetic field taking viscous and Joule dissipations into account.. Seth et.al.,[7] studied the effects of Hall current and rotation on unsteady MHD natural convection flow with heat and mass transfer of an electrically conducting, viscous, incompressible, chemically reacting and optically thin radiating fluid past an impulsively moving infinite vertical plate embedded in a porous medium in the presence of thermal and mass diffusion . Bhupendra Kumar Sharma et.al.,[8] analysed the unsteady MHD mixed convective flow of a viscous incompressible fluid past an infinite vertical porous flat plate in the presence of a heat source/sink with Hall effect.Ramana Reddy et.al.,[9] presented an analysis of the effects of magnetohydrodynamic force and buoyancy on convective heat and mass transfer flow past a moving vertical porous plate in the presence of thermal radiation and chemical reaction.

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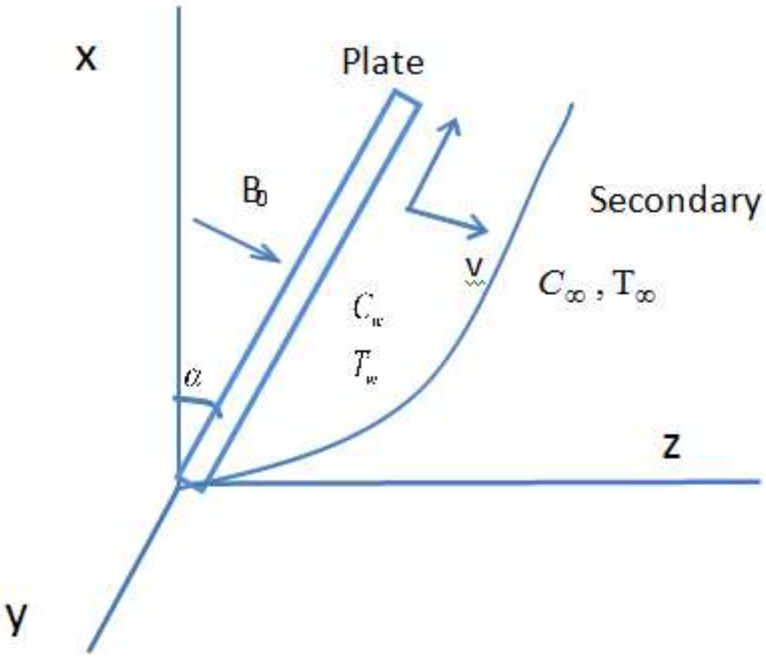
Seth et.al.,[10] analysed unsteady hydromagnetic free convection flow of a viscous, incompressible and electrically conducting fluid past an impulsively moving vertical plate with Newtonian surface heating embedded in a porous medium taking into account the effects of Hall current is carried out. Rajput et.al [11] analyzed Hall current effects on unsteady MHD flow past an impulsively started oscillating inclined plate with variable temperature and mass diffusion in the presence of chemical reaction .

The objective of the paper is to examine the effects of chemical reaction and Hall current on unsteady flow of a viscous, incompressible and electrically conducting fluid past an impulsively started oscillating inclined plate under the influence of transversely applied uniform magnetic field in the presence of heat source with aid of graphs.



Figure(A): Physical diagram

II. MATHEMATICAL FORMULATION

The x axis is taken along the vertical plane and z axis is normal to it. So the z axis lies in the horizontal plane. The plate is inclined at an angle α from vertical. The magnetic field B_0 of uniform strength is applied perpendicular to the fluid flow. It has been considered that the plate as well as the fluid is at the same temperature T_∞ initially. The species concentration in the fluid is taken as C_∞ (see Figure(A)) . At time t > 0, the plate starts oscillating in its own plane with frequency ω and temperature of the plate is raised to T_W . The concentration C near the plate is raised linearly with respect to time. The flow governing equations are as under:

$$\frac{\partial u}{\partial t} = \upsilon \frac{\partial^2 u}{\partial z^2} + g\beta \cos\alpha\left(T - T_\infty\right) + g\beta^* \cos\alpha\left(C - C_\infty\right) - \frac{\sigma B_0^2 (u + mv)}{\rho(1+m^2)} \quad (1)$$

$$\frac{\partial v}{\partial t} = \upsilon \frac{\partial^2 v}{\partial z^2} + \frac{\sigma B_0^2 (mu - v)}{\rho(1+m^2)} \quad (2)$$

$$\rho C_p \frac{\partial T}{\partial t} = k \frac{\partial^2 T}{\partial z^2} + Q'\left(T - T_\infty\right) \quad (3)$$

$$\frac{\partial C}{\partial t} = D^2 \frac{\partial^2 C}{\partial z^2} - Kc\left(C - C_\infty\right) \quad (4)$$

The boundary conditions

$$t \le 0 \quad u = 0, v = 0, T = T_\infty, C = C_\infty \ \forall z$$

$$t > 0 \quad u = u_0 \cos \omega t, v = 0, T = T_\infty + (T_w - T_\infty)\frac{u_0^2 t}{\upsilon}, C = C_\infty + (C_w - C_\infty)\frac{u_0^2 t}{\upsilon} \text{ at } z = 0 \quad (5)$$

$$u \to 0, v \to 0, T \to T_\infty, C \to C_\infty \text{ as } z \to \infty$$

Here u is the primary velocity, v is the secondary velocity, $g$is the acceleration due to gravity, β is the volumetric coefficient of thermal expansion, t isthe time, m is the Hall parameter , Tisthe temperature of the fluid, β*is the volumetric coefficient of concentration expansion, Cisthe species concentration in the fluid, υ is the kinematic viscosity, ρ is the density, C_p is the specific heat at constant pressure, k is the thermal conductivity of the fluid, D is the mass diffusion coefficient, T_w is the temperature of the plate at z= 0, C_w is the species concentration at the plate z= 0, B_0 is the uniform magnetic field, Kc is the chemical reaction, σis the electrical conductivity, Q' is the dimensional heat source parameter.

Non dimensional quantities are

$$\bar{z} = \frac{zu_0}{\upsilon}, \bar{u} = \frac{u}{u_0}, \bar{v} = \frac{v}{u_0}, Sc = \frac{\upsilon}{D}, \mu = \rho\upsilon, M = \frac{\sigma B_0^2 \upsilon}{\rho u_0^2}, Kr = \frac{\upsilon K_c}{u_0^2}, \Pr = \frac{\mu c_p}{K}, \bar{t} = \frac{t u_0^2}{\upsilon},$$

$$Gr = \frac{g\beta\upsilon(T_w - T_\infty)}{u_0^3}, \theta = \frac{(T - T_\infty)}{(T_w - T_\infty)}, Gm = \frac{g\beta^*\upsilon(C_w - C_\infty)}{u_0^3}, \bar{C} = \frac{(C - C_\infty)}{(C_w - C_\infty)}, \bar{\omega} = \frac{\omega\upsilon}{u_0^2}, Q = \frac{Q'\upsilon^2}{Ku_0^2} \quad (6)$$

Where $\bar{u}$ is the dimensionless Primary velocity, $\bar{v}$ is the secondary velocity, $\bar{t}$ is the dimensionless time, θ is the dimensionless temperature, $\bar{C}$is the dimensionless concentration, Gr is the thermal Grashof number, Gm is the mass Grashof number, μ is the coefficient of viscosity, Kr is the chemical reaction parameter, Pr is the Prandtl number, Sc is the Schmidt number, M is the magnetic parameter,Q is the Heat source parameter. The flow model becomes.

$$\frac{\partial \bar{u}}{\partial t} = \frac{\partial^2 \bar{u}}{\partial \bar{z}^2} + Gr(\cos\alpha)\theta + G_m(\cos\alpha)\bar{C} - \frac{M(\bar{u} + m\bar{v})}{(1+m^2)} \quad (7)$$

$$\frac{\partial \bar{v}}{\partial t} = \frac{\partial^2 \bar{v}}{\partial \bar{z}^2} + \frac{M(m\bar{u} - \bar{v})}{(1+m^2)} \quad (8)$$

$$\frac{\partial \bar{C}}{\partial \bar{t}} = \frac{1}{Sc}\frac{\partial^2 \bar{C}}{\partial \bar{z}^2} - Kr\bar{C} \quad (9)$$

$$\frac{\partial \theta}{\partial \bar{t}} = \frac{1}{\Pr}\frac{\partial^2 \theta}{\partial \bar{z}^2} + \frac{1}{\Pr}Q\theta \quad (10)$$

The corresponding boundary conditions are

$$\bar{t} \le 0 : \bar{u} = 0, \bar{v} = 0, \theta = 0, \bar{C} = 0 \text{ for all } \bar{z}$$

$$\bar{t} > 0 : \bar{u} = \cos \bar{\omega}\bar{t}, \bar{v} = 0, \theta = \bar{t}, \bar{C} = \bar{t} \text{ at } \bar{z} = 0 \quad (11)$$

$$\bar{u} \to 0, \bar{v} \to 0, \theta \to 0, \bar{C} \to 0 \text{ as } \bar{z} \to \infty$$

Dropping the bars we get

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial z^2} + Gr(\cos\alpha)\theta + G_m(\cos\alpha)C - \frac{M(u + mv)}{(1+m^2)} \quad (12)$$

$$\frac{\partial v}{\partial t} = \frac{\partial^2 v}{\partial z^2} + \frac{M(mu - v)}{(1+m^2)} \quad (13)$$

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$$\frac{\partial C}{\partial t}=\frac{1}{Sc}\frac{\partial^2 C}{\partial z^2}-KrC \quad (14)$$

$$\frac{\partial \theta}{\partial t}=\frac{1}{\Pr}\frac{\partial^2 \theta}{\partial z^2}+\frac{1}{\Pr}Q\theta \quad (15)$$

The corresponding boundary conditions are

$$t\le 0: u=0, v=0, \theta=0, C=0 \text{ for all } z$$
$$t>0: u=\cos\omega t, v=0, \theta=t, C=t \text{ at } z=0 \quad (16)$$
$$u\to 0, v\to 0, \theta\to 0, C\to 0 \text{ as } z\to\infty$$

The dimensionless governing equations (12) to (15), subject to the boundary conditions (16), are solved by the usual Laplace - transform technique.The solution obtained is as under:

$$\begin{aligned}
q(z,t)=&\frac{1}{2}\left[\frac{e^{-i\omega t}}{2}\left(e^{-z\sqrt{a-i\omega}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{(a-i\omega)t}\right)+\left(e^{z\sqrt{a-i\omega}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{(a-i\omega)t}\right)\right)\right)\right]\\
&+\frac{1}{2}\left[\frac{e^{i\omega t}}{2}\left(e^{-z\sqrt{a+i\omega}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{(a+i\omega)t}\right)+\left(e^{z\sqrt{a+i\omega}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{(a+i\omega)t}\right)\right)\right)\right]\\
&+\frac{b_{10}}{2}\left[e^{-z\sqrt{a}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{at}\right)+e^{z\sqrt{a}}erfc\left(\frac{z}{2\sqrt{t}}+\sqrt{at}\right)\right]\\
&+b_{11}\left[\left(\frac{t}{2}-\frac{z}{4\sqrt{a}}\right)e^{-z\sqrt{a}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{at}\right)+\left(\frac{t}{2}+\frac{z}{4\sqrt{a}}\right)e^{z\sqrt{a}}erfc\left(\frac{z}{2\sqrt{t}}+\sqrt{at}\right)\right]\\
&-\frac{b_6e^{-b_3t}}{2}\left[e^{-z\sqrt{a-b_3}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{(a-b_3)t}\right)+e^{z\sqrt{a-b_3}}erfc\left(\frac{z}{2\sqrt{t}}+\sqrt{(a-b_3)t}\right)\right]\\
&-\frac{b_8e^{-b_5t}}{2}\left[e^{-z\sqrt{a-b_5}}erfc\left(\frac{z}{2\sqrt{t}}-\sqrt{(a-b_5)t}\right)+e^{z\sqrt{a-b_5}}erfc\left(\frac{z}{2\sqrt{t}}+\sqrt{(a-b_5)t}\right)\right]\\
&-\frac{b_6}{2}\left[e^{-z\sqrt{\Pr b_1}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}-\sqrt{b_1t}\right)+e^{-z\sqrt{\Pr b_1}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}-\sqrt{b_1t}\right)\right]\\
&-b_7\left[\left(\frac{t}{2}-\frac{z\sqrt{\Pr}}{4\sqrt{b_1}}\right)e^{-z\sqrt{\Pr b_1}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}-\sqrt{b_1t}\right)+\left(\frac{t}{2}+\frac{z\sqrt{\Pr}}{4\sqrt{b_1}}\right)e^{-z\sqrt{\Pr b_1}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}+\sqrt{b_1t}\right)\right]\\
&+\frac{b_6e^{-b_3t}}{2}\left[e^{-z\sqrt{\Pr}\sqrt{b_1-b_3}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}-\sqrt{(b_1-b_3)t}\right)+e^{z\sqrt{\Pr}\sqrt{b_1-b_3}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}+\sqrt{(b_1-b_3)t}\right)\right]\\
&-\frac{b_8}{2}\left[e^{-z\sqrt{ScKr}}erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}-\sqrt{Krt}\right)+e^{z\sqrt{ScKr}}erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}+\sqrt{Krt}\right)\right]\\
&-b_9\left[\left(\frac{t}{2}-\frac{z\sqrt{Sc}}{4\sqrt{Kr}}\right)e^{-z\sqrt{ScKr}}erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}-\sqrt{Krt}\right)+\left(\frac{t}{2}+\frac{z\sqrt{Sc}}{4\sqrt{Kr}}\right)e^{z\sqrt{ScKr}}erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}+\sqrt{Krt}\right)\right]\\
&+\frac{b_8e^{-b_5t}}{2}\left[e^{-z\sqrt{Sc}\sqrt{Kr-b_5}}erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}-\sqrt{(Kr-b_5)t}\right)+e^{z\sqrt{Sc}\sqrt{Kr-b_5}}erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}+\sqrt{(Kr-b_5)t}\right)\right]
\end{aligned}$$

$$T(z,t)=\left(\frac{t}{2}-\frac{z\sqrt{\Pr}}{4\sqrt{b_1}}\right)e^{-z\sqrt{\Pr b_1}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}-\sqrt{b_1t}\right)+\left(\frac{t}{2}+\frac{z\sqrt{\Pr}}{4\sqrt{b_1}}\right)e^{-z\sqrt{\Pr b_1}}erfc\left(\frac{z\sqrt{\Pr}}{2\sqrt{t}}+\sqrt{b_1t}\right)$$

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$$C(z,t)=\left(\frac{t}{2}-\frac{z\sqrt{Sc}}{4\sqrt{Kr}}\right)e^{-z\sqrt{ScKr}}\,erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}-\sqrt{Krt}\right)+\left(\frac{t}{2}+\frac{z\sqrt{Sc}}{4\sqrt{Kr}}\right)e^{z\sqrt{ScKr}}\,erfc\left(\frac{z\sqrt{Sc}}{2\sqrt{t}}+\sqrt{Krt}\right)$$

III. RESULTS AND DISCUSSIONS

The velocity profile for different parameters like, Hall parameter (*m*),Schmidt number(Sc), chemical reaction parameter(*Kr*), Phase angle ωt, magnetic field parameter (*M*), Heat generation parameter (Q) and angle of inclination (α)are shown in Figures 1 to 7. The secondary velocity profile for different parameters like, Hall parameter (*m*),Schmidt number (Sc), chemical reaction parameter(*Kr*), mass Grashof number (Gm), Phase angle (ωt), magnetic field parameter (*M*), Heat source parameter (Q) and angle of inclination (α) are shown in Figures 8 to 15.The temperature profile for different parameter like Phase angle (ωt), Prandtl number (*Pr*), Heat generation parameter (Q) are shown in figures 16 to 18.The concentration profile for different parameters like Schmidt number (Sc), chemical reaction parameter (Kr),Phase angle (ωt) are shown in Figure 19 to 20. It is observed from Figures 1 and 8 that the primary velocity increases whereas secondary velocities of fluid decrease when the Hall parameter m increases. Figures 3,10 and 20depicts that as chemical reaction parameter Kr increases primary velocity ,secondary velocity as well as concentration of the fluid decreases. This implies that chemical reaction tends to decelerate primary and secondary velocities throughout the boundary layer region near the plate. By observing figures 6,14 and 18 it is evident that primary velocity, secondary velocity and temperature of the fluid increases when heat source parameter increases. From figures 2, 9 and 19 it is concluded that as Schmidt number Sc increases primary velocity, secondary velocity as well as concentration of the fluid decreases. Physically, the increase of Scmeans decrease of molecular diffusivity (D)**.**The concentration of the fluid near the inclined plate is lower for large values of (Sc). From figure 11 it is evident that as mass Grashof number(Gm) increases secondary velocity of the fluid increases. Also by observing figure17 it deduced that the temperature of the fluid decreases as Prandtl number (Pr)**.** From figures 5 and 13 it is observed that the effect of increasing values of the parameter M results in decreasing in primary velocity and increasing in secondary velocity. It is observed from Figures 4,12and 16 it is deduced that when phase angle ωt increases, both the velocities are decreased and temperature of the fluid increases. From figures 7 and 15 it is observed that as angle of inclination of the plate from vertical increases both the velocities decreases.

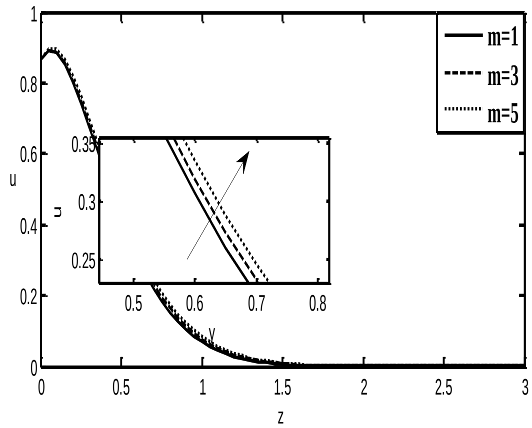

Figure 1. Velocity for various values of m with

$Sc=2.01, Gr=10, Gm=100, Kr=3.0, Q=1,\ \omega t=\frac{\pi}{6},\ \alpha=\frac{\pi}{6}, M=2, \Pr=0.71$

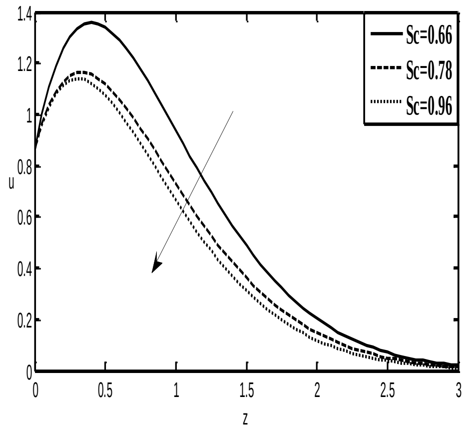

Figure 2. Velocity for various values of Sc with

$m=1, Gr=10, Gm=10, Kr=3.0, Q=1,\ \omega t=\frac{\pi}{6},\ \alpha=\frac{\pi}{6}, M=2, \Pr=0.71$

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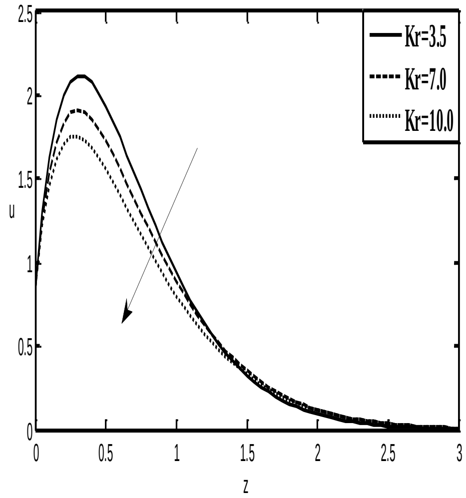

Figure.3. Velocity for various values of Kr with

$m = 1, Gr = 10, Gm = 100, Sc = 2.01, Q = 1, \omega t = \frac{\pi}{6}, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71$

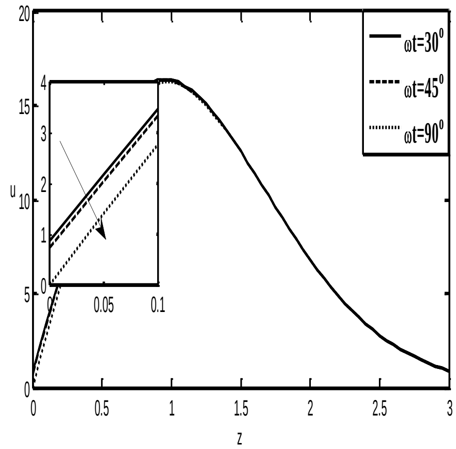

Figure 4. Velocity for variousvalue of ωt with

$m = 1, Sc = 2.01, Gr = 10, Gm = 100, Kr = 5, Q = 1, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71$

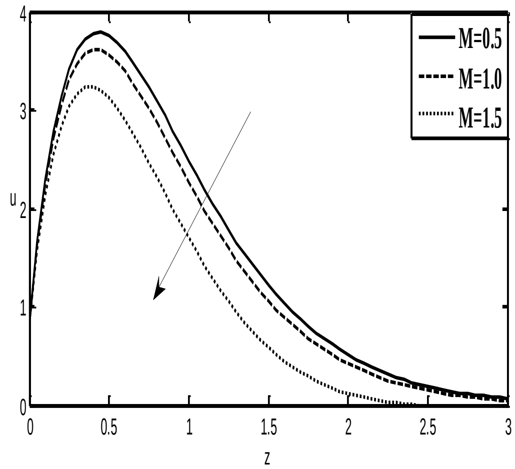

Figure.5. Velocity for various values of M with

$m = 1, Gr = 10, Gm = 100, Sc = 2.01, Q = 1, \omega t = \frac{\pi}{6}, \alpha = \frac{\pi}{6}, Kr = 2.5, Pr = 0.71$

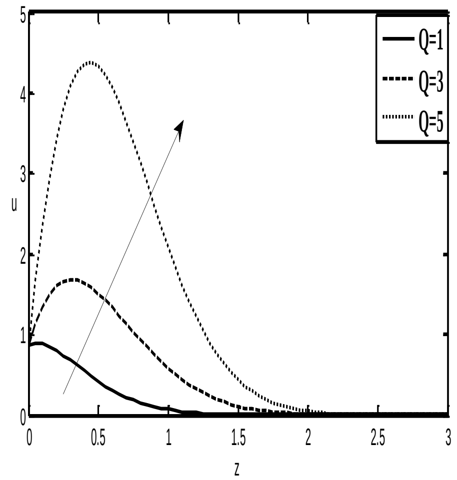

Figure 6. Velocity for various values of Q with

$m = 1, Sc = 2.01, Gr = 10, Gm = 100, Kr = 2.5, \omega t = \frac{\pi}{6}, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71$

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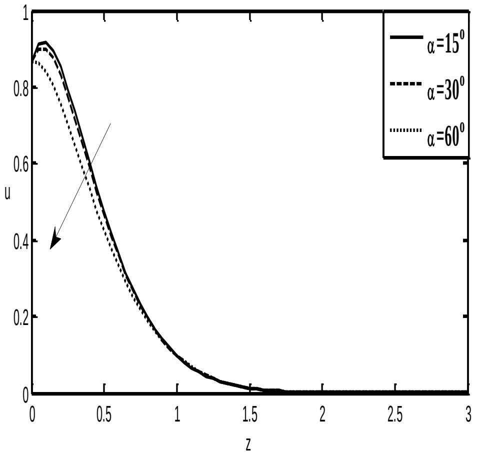

Figure 7. Velocity for various values of α with

$m = 1, Gr = 10, Gm = 100, Sc = 2.01, Q = 1, \omega t = \frac{\pi}{6}, Kr = 5, M = 2, Pr = 0.71$

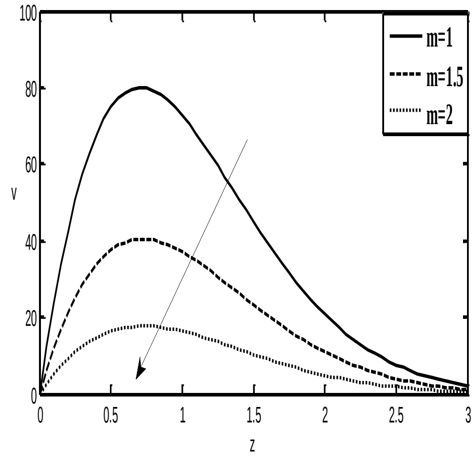

Figure 8. Secondary velocity for various values of **m** with

$Sc = 2.01, Gr = 10, Gm = 100, Kr = 0.1, Q = 1, \omega t = \frac{\pi}{6}, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71$

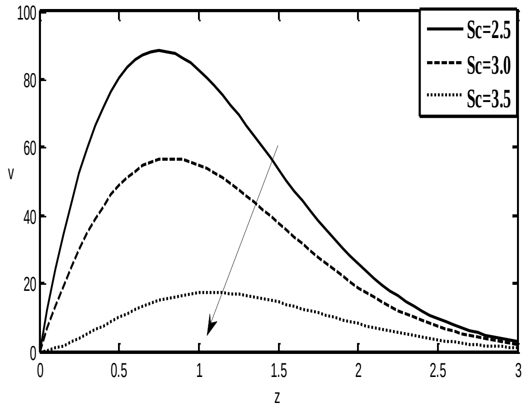

Figure 9. Secondary velocity for various values of **Sc** with

$Gr = 10, Gm = 100, Kr = 0.1, Q = 1, \omega t = \frac{\pi}{6}, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71, m = 1$

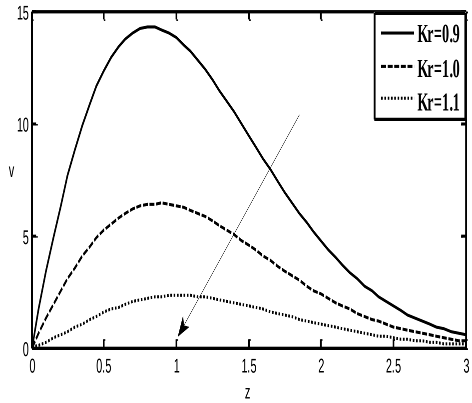

Figure 10. Seondary velocity for various values of Kr with

$Sc = 2.01, Gr = 10, Gm = 100, Q = 1, \omega t = \frac{\pi}{6}, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71, m = 1$

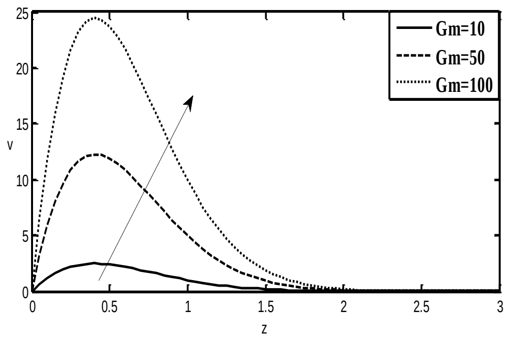

Figure 11. Secondary velocity for various values of **Gm** with

$Sc = 2.01, Gr = 10, Kr = 0.1, Q = 1, \omega t = \frac{\pi}{6}, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71, m = 1$

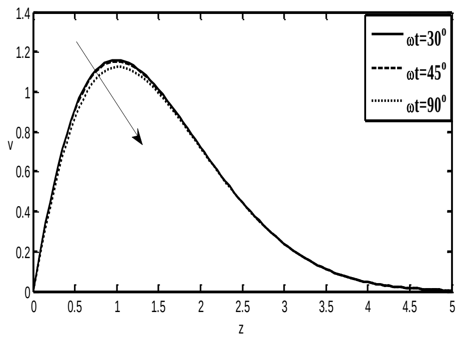

Figure 12. Secondary velocity for various values of ωt with

$Sc = 2.01, Gr = 10, Gm = 100, Q = 1, \alpha = \frac{\pi}{6}, M = 2, Pr = 0.71, m = 1, Kr = 0.1$

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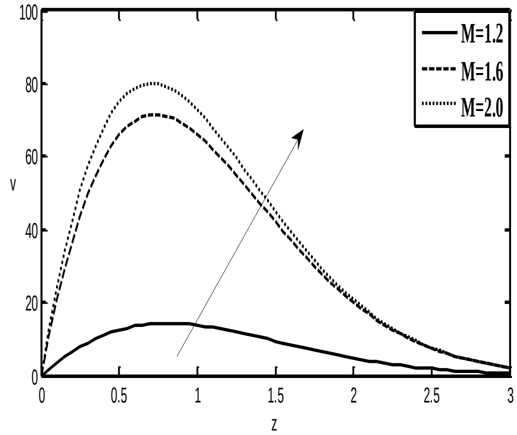

Figure 13. .Secondary velocity for various values of **M** with

$Sc=2.01, Gr=10, Gm=100,\ Q=1,\ \omega t=\frac{\pi}{6},\ \alpha=\frac{\pi}{6}, \Pr=0.71, Kr=0.1, m=1$

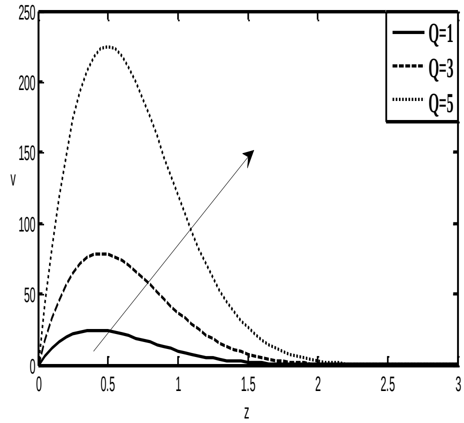

Figure 14. Secondary velocity for various values of Q with

$Sc=2.01, Gr=10, Gm=100,\ M=2,\ \omega t=\frac{\pi}{6},\ \alpha=\frac{\pi}{6}, \Pr=0.71, Kr=0.1, m=1$

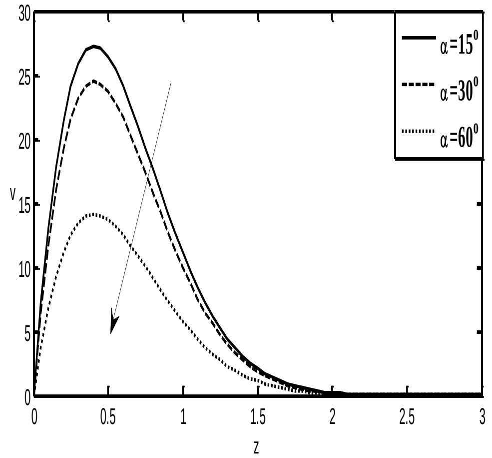

Figure 15..Secondary velocity for various values of ‘ α ’ with

$Sc=2.01, Gr=10, Gm=100,\ M=2,\ \omega t=\frac{\pi}{6},\ \alpha=\frac{\pi}{6}, \Pr=0.71, Kr=0.1, m=1$

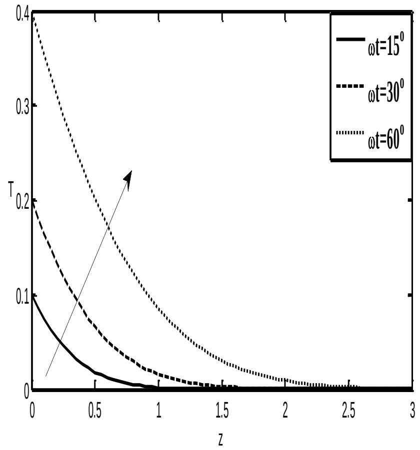

Figure 16. Temperature for variousvalue of ωt with

$m=1, Sc=2.01,\ Gr=10, Gm=100, Kr=2.5, Q=1,\ \ \alpha=\frac{\pi}{6}, M=2, \Pr=0.71$

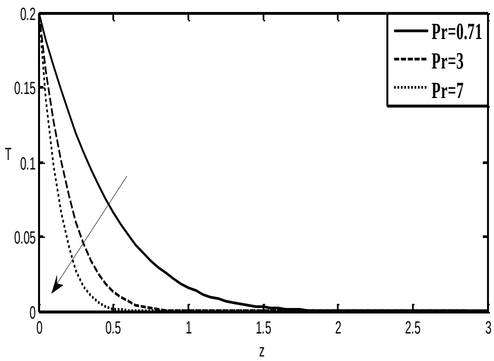

Figure 17. Temperature for variousvalue of **Pr** with

$m=1, Sc=2.01,\ Gr=10, Gm=100, Kr=2.5, \omega t=\frac{\pi}{6}, Q=1,\ \ \alpha=\frac{\pi}{6}, M=2$

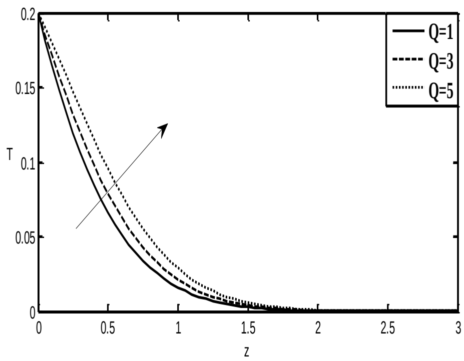

Figure 18. Temperature for variousvalue of Q with

$m=1, Sc=2.01,\ Gr=10, Gm=100, Kr=2.5,\ \omega t=\frac{\pi}{6}, \alpha=\frac{\pi}{6}, M=2, \Pr=0.71$

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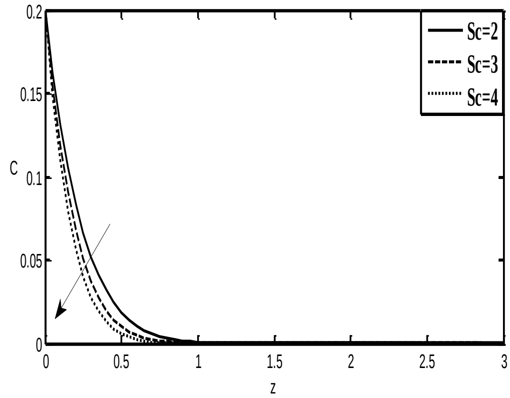

Figure 19. Concentration for various values of **Sc** with
$Gr=10, Gm=100, Kr=2.5, Q=1, \omega t=\frac{\pi}{6}, \alpha=\frac{\pi}{6}, M=2, Pr=0.71, m=1$

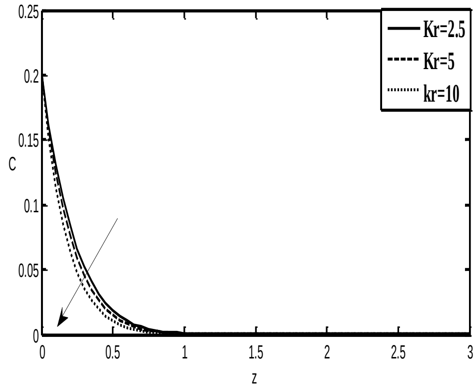

Figure.20. Concentration for various values of Kr with
$m=1, Gr=10, Gm=100, Sc=2.01, Q=1, \omega t=\frac{\pi}{6}, \alpha=\frac{\pi}{6}, M=2, Pr=0.71$

IV. CONCLUSIONS

The following are the important key points

1. As Hall parameter increases primary velocity increases whereas secondary velocity decreases.
2. As chemical reaction parameter increases primary velocity, secondary velocity and concentration of the fluid decreases.
3. As heat source parameter increases primary velocity, secondary velocity and temperature of the fluid increases.
4. As angle of inclination of the plate with vertical increases primary velocity and secondary velocity of the fluid decreases.
5. As phase angle increases primary velocity and secondary velocity of the fluid decreases whereas temperature of the fluid. Increases.

V. REFERENCES

[1]. V.M.Sundalgekar,S.ravi and S.B.Hiremath,Hall effects on MHD flow past an accelerated plate,J.Plasma Physics,Vol.23,part.3,pp.495-500,1980.
[2]. C.B.Gupath and S.B.Guptha,Oscillatory MHD flow past an oscillating flat plate with hall current,Proc.Indian.natn.Sci.Acad,Vol.no.50,A.N0.6,pp.583-593,1984.
[3]. MD.AbdusSattar and MD.MahmudAlam,MHD free convective heat and mass transfer flow with Hall current and constant heat flux through a porous medium,Indian.J.Pure appl.Math,vol.26(2),pp.157-167,1995.
[4]. EmadM.Aboeldahab and ElsayedM.E.Elbarbary,Hall current effects on magnetohydrodynamic free-convection flow past a semi-infinite vertical plate with mass transfer,International Journal of Engineering Science,vol.39,pp.1641-1652,2001.
[5]. Stanford Shateyi, Sandile Sydney Motsa and Precious Sibanda, The Effects of Thermal Radiation, Hall Currents, Soret, and Dufour on MHD Flow by Mixed Convection over a Vertical Surface in Porous Media,Hindawi Publishing Corporation Mathematical Problems in Engineering, vol.2010,pp.1-20,2010.
[6]. B.C.Sarkar,S.Das and R.N.Jana,Hall effects on unsteady MHD free convection flow past an accelerated moving vertical plate with viscous and jouldissipation,International Journal of Computer Applications,vol.70,no.4,pp.20-28,2013.
[7]. G.S.Seth, S.M.Hussain and S.Sarkar, Effects of Hall current and rotation on unsteady MHD natural convection flow with heat and mass transfer past an impulsively moving vertical plate in the presence of radiation and chemical reaction, Bulgarian Chemical Communications,vol.44,No.4,pp.704-718,2014

[8]. Bhupendra Kumar Sharma, Abhay Kumar Jha and R. C. Chaudhary, Hall Effect On Mhd Mixed Convective Flow Of A Viscous Incompressible Fluid Past A Vertical Porous Plate Immersed In Porous Medium With Heat Source/Sink, Rom. Journ. Phys.,vol.52,pp.487-503,2007

[9]. G.V. Ramana Reddy, N. Bhaskar Reddy And R.S.R. Gorla ,Radiation And Chemical Reaction Effects On Mhd Flow Along A Moving Vertical Porous Plate,Int. J. of Applied Mechanics and Engineering, vol.21, No.1, pp.157-168, 2016

[10]. G.S. Seth , S. Sarkar and R. Sharma, Effects Of Hall Current On Unsteady Hydromagnetic Free Convection Flow Past An Impulsively Moving Vertical Plate With Newtonian Heating,Int. J. of Applied Mechanics and Engineering, vol.21, No.1, pp.187-203, 2016.

[11]. U S Rajput, Gaurav Kumar,Chemical Reaction Effect On Unsteady Mhd Flow Past An Impulsively Started Oscillating Inclined Plate With Variable Temperature And Mass Diffusion In The Presence Of Hall Current, Applied Research Journal, Vol.2,No.5,pp. 244-253,2016

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